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THE CATAMARAN, OR DOUBLE-HULLED SAIL-BOAT.

By PADDLEFAST.

IN the Centennial regatta of the New York Yacht Club, a strange little boat entered the race. It was so diminutive—24 feet long—and so oddly built, that it encountered great laughter and ridicule. Of course, as soon as her stately compeers had fairly filled their sails, this impertinent raft would be left far behind. So it was thought, but ridicule gave way to wonder when in time the little boat was seen to creep ahead of vessels ten times her length. One and another of her competitors were left behind, and the Amaryllis—for such was her name—stood among the foremost. Still nobody was prepared for the result, which provoked universal applause when this tiny affair passed the goal fifteen minutes ahead of every vessel in the fleet, without correction for time allowance.

The Amaryllis was designed and built by Mr. N. G. Herreshoff, of Bristol, R. I., to whom we are indebted for much of our information. This, his first boat, places beyond dispute the possible speed of catamarans. But what additional merits have they? Increased safety is one, the stability being so great that the entire rig has been blown from these boats without capsizing them, and the builder of the Amaryllis states that after sailing her in all winds and weathers he has yet to see the windward hull lifted clear of the water. Another recommendation that the lady passengers appreciate is the comparative freedom from pitching and careening. Then, too, there is less spray and no shifting of ballast; the boat is easily handled, and can be poled in a calm with very little exertion. We hope to make it plain in a succeeding paper that a catamaran may be more readily built than a single-hulled yacht of equal length, so that their construction will be easy to the most unskilled. It is not claimed that the catamaran can supersede the single-hulled boat; it can lay no closer to the wind, it cannot carry so many passengers, and, though the deck can be spacious and a tent pitched over it at night, the boat seems not so well fitted for cruising. Catamarans are not good sea boats—Mr. Herreshoff's boats excepted. Finally the catamaran has two faults, namely, it is slow in stays, and is prone to "pitch pole," or upset endwise, as the Amaryllis once did. These evils can be much palliated by proper construction.

The catamaran is not new. The word is borrowed from the East and West Indies and South America, where it is applied to native rafts of three pointed logs; the large craft of this sort carrying sails and being used as lighters. The double-hulled boat was originated by some Feejee Island genius, doubtless an enthusiastic lover of aquatic sports, but not instructed in civilized carpentry. His sole material was the log, and no boat could he build with greater beam and stability than the dug-out. No safe sailing being possible in such a concern, he hit on the happy expedient of joining two canoes by an intervening deck, and at once invented the well-known Feejee war canoe and the "catamaran" of Yankeedom.

The Feejee boat and the majority of catamarans possess this objection—in rough water the independent motions of the hulls will ultimately wrench them from the deck, unless the connections are excessively heavy. An important requisite of speed is lightness. No boat can sail well that possesses such solidity as to bind the two hulls immovably together. How to make a light deck frame which will control motions which it cannot resist is the problem which in boats of Mr. Herreshoff's build is well solved.

The Amaryllis, Arion, Teaser, John Gilpin and Tarantella, the catamarans which Mr. Herreshoff has built thus far, are substantially alike, differing only in details and size. As the reader could gain no clearer idea of the peculiarities of these boats than by reading Mr. Herreshoff's patent specifications, we subjoin an extract therefrom, to be read in connection with the accompanying illustrations of the "John Gilpin."

"A A are respectively the port and starboard hulls, each complete in itself, and constructed with a centreboard case, centreboard, O, rudder, etc. There should be a tight deck on each, with provisions for pumping. In large vessels, the space below deck in each hull may be utilized. I will describe this as too small to allow such to be effected with economy.

Points near the bow of each hull are connected by slightly curved beams, B, trussed with rods, b, and united to the hulls at each end by universal joints, C C. A similar trussed beam is similarly jointed to each hull near the stern. The hulls may pitch independently of each other, and the universal joints, C, will impose no restraint on the movement. A straight timber, M, extends longitudinally along the centre, just below the transverse pieces, B, and secured to each. Two straight sticks, D, extend across at a higher elevation, about midway between stem and stern. An upright, or nearly upright link, E, bears on each hull a little one side of the centre line, with a universal joint free to work in all directions. The upper end of each link, E, is similarly jointed to the under side of the cross-piece, D. G'' is a car of light, oval form, G being a deck, and G'' the standing-room, with a suitable raised rim or bulwark, adapted to accommodate persons, stores, etc. The car is secured to both the transverse beams, D, and the longitudinal piece, M It is furthermore secured to the mast, H, which it aids to support, and by which it is in turn supported. The weight of any load upon the car, G'' is transmitted to the hulls, A, through the medium, mainly, of the cross-beams, D, and upright links, E, which bear amidships, and partly through the other cross-pieces, B, which bear near the ends, respectively.

Stiff diagonal braces, D', connect the ends of the beams, D, with the bowsprit, which latter is also firmly connected to the mast.

A short upright, M', is fixed to the forward end of the piece, M, and aids to support the bowsprit, I. It also receives a bob-stay, m, which extends from the forward end of the bowsprit under the piece, M', to the foot of the mast, H. Another fore-and-aft stay, m', extends from the foot of the mast to the after end of the timber, M. Two other stays, h h, connect the foot of the mast with each end of the cross-beams, D, and still another, h', with the top of the upright, M'. A pair of stays, d d, connect the ends of the cross-beams, D, with the front end of the timber, M, and another pair, d' d', connect the same ends with a point near the after end of the same beam, M. All these may be steel wire galvanized, tinned, or otherwise protected from oxidation. The whole produces a light framework, supporting the deck and its load, and also the mast and bowsprit, upon the hulls, with freedom for the latter to both pitch and roll.

An elastic restraint upon the rolling is imposed through the medium of arms, A^1 A^1, of ash, or other strong and elastic material, extending from each hull toward the other, and terminating near, but not touching, the central timber, M. These arms, A^1, may be connected to the boat, through the medium of bolts, with India rubber washers, or the like, to increase the elasticity.

Their inner extremities are connected by links, A^2, with

THE CATAMARAN, OR DOUBLE SAIL BOAT "TARANTELLA."

an inner piece, G', of ash or other elastic material, held a little below the deck, G. When, in either a ground swell or a chopping sea, one or both the hulls seeks to roll, the motion is arrested simply by this train of elastic connections. The result is a limited freedom of the rolling, the pieces, A^1 and G' yielding upward and downward to accommodate the motion, and promptly bringing each hull to an even keel so soon as the disturbing strain is diminished.

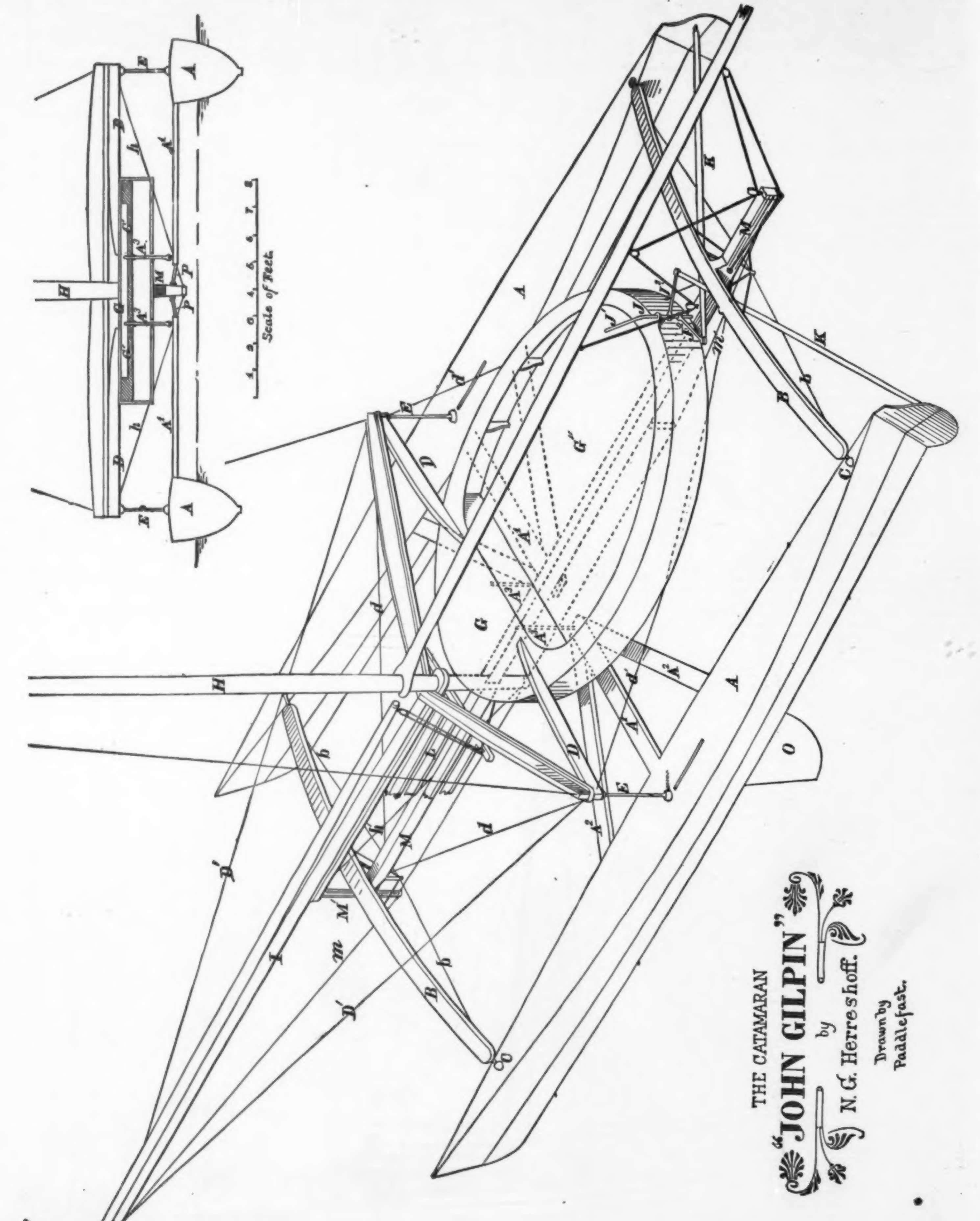
The helm, J^1, is applied, not on either of the rudder-heads, but on a separate shaft, J, in the central part of the structure, and further forward than the rudders. On the lower end of this shaft are arms, J^2, extending obliquely backward. To the end of each a rod, K, is jointed, which connects to an arm on the rudder on the opposite side—that is to say, the rod K from the port arm, J^2, extends to the starboard rudder, and the rod K from the starboard arm, J^2, extends to the port rudder.

In turning a double boat, one hull necessarily makes a shorter turn, or describes a curve of less radius than the other. This requires that the rudders of the two boats should be turned to unequal extents, the boat which is the inside one, or nearest the centre of the curvature, having its rudder turned to the greatest angle. Such motion is obtained through my arrangement.

If the compound vessel is to be turned to port, the helm is put starboard in the usual manner; turning the arms, J^2 J^2, to the same extent, but by reason of their oblique position and their being centered considerably in advance of the rudder-posts, the port rudder is turned through a greater arc than the other. When, on the other hand, the vessel is to be turned to starboard, the helm, J^1, is put to port, as usual, and the rudder on the starboard boat, which is then on a smaller circle, turns through the greatest arc.

Each side, and below the bowsprit, are longitudinal pieces, L, of hard wood, which, in addition to their obvious service as supports for men handling the job, contribute some what to the strengthening of the framework."

In the John Gilpin, the space beneath the deck, G, is divided into two parts, the after one containing the elastic beam, G', and the forward being used as a locker. The elastic arms, A^1, are strengthened by the diagonal arms, A^2



Also the inner or free ends of the elastic arms, A¹, are connected with the mast by links, P, shown in the sectional view. The sheet is run along the longitudinal timber, M, thence through the floor of the standing-room, G².

The dimensions of the John Gilpin are as follows: Length of hull, over all, about 32 feet; width of each hull, on deck, 28 inches; depth of each hull at ends, 2 feet 5 inches; draft of hulls, with load, 1 foot at each end, and probably about 21 inches amidships; distance of hulls apart from centre to centre, 16 feet; mast is stepped 12 feet 10 inches from extreme bows. The car is 14 feet 10 inches long; length of bowsprit, 22 feet 8 inches; length of boom, 31 feet 4 inches. Mainsail and jib are of the usual shape. The upright links, E, are 16 feet 6 inches from extreme bows, and the centre boards O are immediately abaft, with wells 2 feet long on deck. The boats draw 4 feet with centreboards down. The rudders are about 2 feet long. In every part lightness and strength seem combined. The mast is very light, being about 5½ inches diameter at H, and tapered to the foot. The shrouds are each three loose wires of the usual telegraph size. The ironwork is galvanized throughout. Weight of boat, completely equipped, about 3,300 lbs. It will carry seven or eight passengers, but the best speed is with the fewest on board. The cost was $1,000.

Of the Tarantella, more recently built, Mr. Herreshoff speaks in the highest terms. The only point of difference between the Gilpin and the Tarantella is that the latter is 15 inches longer. The Tarentella, a perspective view of which we give, has been timed to make 18 miles per hour, with the wind free, and the maximum speed to windward, Mr. Herreshoff states, is 6½ miles per hour.

In reply to inquiries, the present owner of the John Gilpin states that she has never entered a race, nor been timed over a measured course. He prefers the John Gilpin to any other open boat, for the greater speed, comfort and safety. The jointed deck-frame gives perfect satisfaction, and he does not believe that a rigid one would do as well in any water. The boat makes no leeway in smooth water, but a rough sea lifts her bodily to leeward. She steers very readily, but does not come about as quickly as a single-hulled boat. He has seen the stern of the weather boat raised about 18 inches out of water with the bow submerged, but that is the nearest he ever came to capsizing endwise. Her motions are easier than any other boat of the same size, but when driven very hard in rough water she is very wet.

ECONOMY IN STEAM.*

It is a fact well known among engineers that in practice 5 per cent only, or about 1-20th part of the heat that coal can produce, according to theoretical calculations, is actually transformed into motive-power, and that consequently 19 kilos. of coal out of every 20 are entirely lost. It may with certainty be stated that the theoretical efficiency of coal will never be practically realized, but the numerous attempts that been made in this direction, and partly with success, show that a diminution of this enormous loss of heat is considered possible, and remains to be realized. The object of the invention of Mr. T. R. RIETH, of Bonn, Rhenish Prussia, is to reduce to a mimimum the most important cause of this loss of heat. This cause is due to the fact that the large amount of air which passes into the furnace, added to the products of combustion, leads away in a useless manner into the atmosphere a large quantity of heat. To give an idea of the enormity of this loss it is sufficient to state that in well constructed boilers of marine engines the temperature of the products of combustion arriving in the chimney is raised to 250° centigrade, and that it attains even 300° in some boilers. This temperature is sufficient to produce again at least the same quantity of vapor at the same pressure as that of the steam already produced in the steam boiler, and that by employing it to vaporize a hydrocarbon, the point of ebullition of which is about 60°.

Theoretically speaking, it may be admitted that the temperature of the products of combustion in the furnace thus employed to vaporize hydrocarbon will be lowered to 100° of heat; there will, consequently, have been an absorption of heat of from 200° to 300°, heat which has been employed to produce power. A hydrocarbon of any point of ebullition desired may be used. It will, of course, be best to employ one whose point of ebullition is as low as possible, on account of condensation. To the objection of danger from fire, it is sufficient to state that nowadays boilers are made perfectly steam-tight, that steam coming out of a little opening could not take fire, because it would not directly touch the flames. In addition to this, in employing dry boilers, or boilers without liquid, the total quantity of hydrocarbon stored will be so small that there need be no dread of fire.

Suppose, for example, the invention be applied to an ordinary steam-engine, with steam-boiler of any construction, Mr. Rieth adds a new part a second boiler, destined to vaporize the hydrocarbon liquid. This boiler, called "dry," is placed either behind the engine or behind the first boiler. The steam-pipe of the hydrocarbon vapor boiler leads to a second motor machine, which in working puts into action a feed-pump. The vapor coming from the cylinder of the second machine enters a condenser cooled from outside. The gases escaping from the furnace after having left the steam-boiler do not enter immediately into the chimney as at present, but circulate round the outside of the second boiler. At the same time each lift of the piston of the feed-pump drives back into the boiler a certain quantity of hydrocarbon liquid. Thi squantity is measured exactly, so that after its vaporization it is sufficient to produce the necessary pressure to displace the piston in the steam-cylinder. After the piston of the steam-cylinder has reached the end of its course the communication with the condenser takes place by a valve. In this manner a vacuum is produced, which in the return course of the piston produces the same effect as that in an ordinary condenser. At the same time the feed-pump takes at the proper time from the condenser the same quantity of hydrocarbon liquid, and drives it back into the dry boiler in such a manner that the vapor from this latter when the piston returns produces a motive force upon the other side of the piston. This action is repeated regularly, as in all ordinary condensers. To prevent the hydro-carbon vapor cooling too much in the cylinder, or, on the contrary, augmenting its expansion, it is desirable to encase the steam-cylinder and the steam-pipe of the second machine. In this casing the steam from the first boiler is allowed to circulate. This last utilization of steam presents a certain analogy to the proposition of Mr. Verdal, of Tremblay.

The steam from the first machine having been used may also be led to a condenser after having served to maintain the cylinder and the steam pipes of the second machine warm, and, consequently, whenever possible it will be best to make the first machine serve as a condenser. If this does not do the steam may be added to the gases from the furnace to increase the draft after having served as before stated. With great care the point of ebullition of the hydrocarbon may be fixed once for all for each machine, as only a small quantity of hydrocarbon will be consumed in the boiler. It is claimed, moreover, that the boiler will not require repairing, because incrustation will be impossible, and because the back plate cannot be destroyed by fire.

For these reasons, in applying the invention to marine engines, additional hydrocarbon boilers can be placed in a separate place, and if once for all the fastenings have been carefully done the boiler may be left to itself. It need scarcely be stated that caoutchouc, or India rubber, must not be used for the joints, some fire-resisting material, such as asbestos, being necessary. It is claimed that the invention may be applied with advantage to all machines which have at their disposal sufficient water for condensing purposes, but it is especially applicable to marine engines of all kinds, because the advantage for them is double, seeing that the expense of firing is saved and much room is gained. The advantages which the invention is said to offer are very numerous, the most prominent of which appear to be that no extra expense for working is required, and that the boiler may be constructed having regard only to the pressure and to the greatest possible surface, and in accordance with the most complicated systems of boilers, with straight tubes or bent, which cannot be used for steam-boilers, on account of the difficulty of cleaning.—*Mining Journal.*

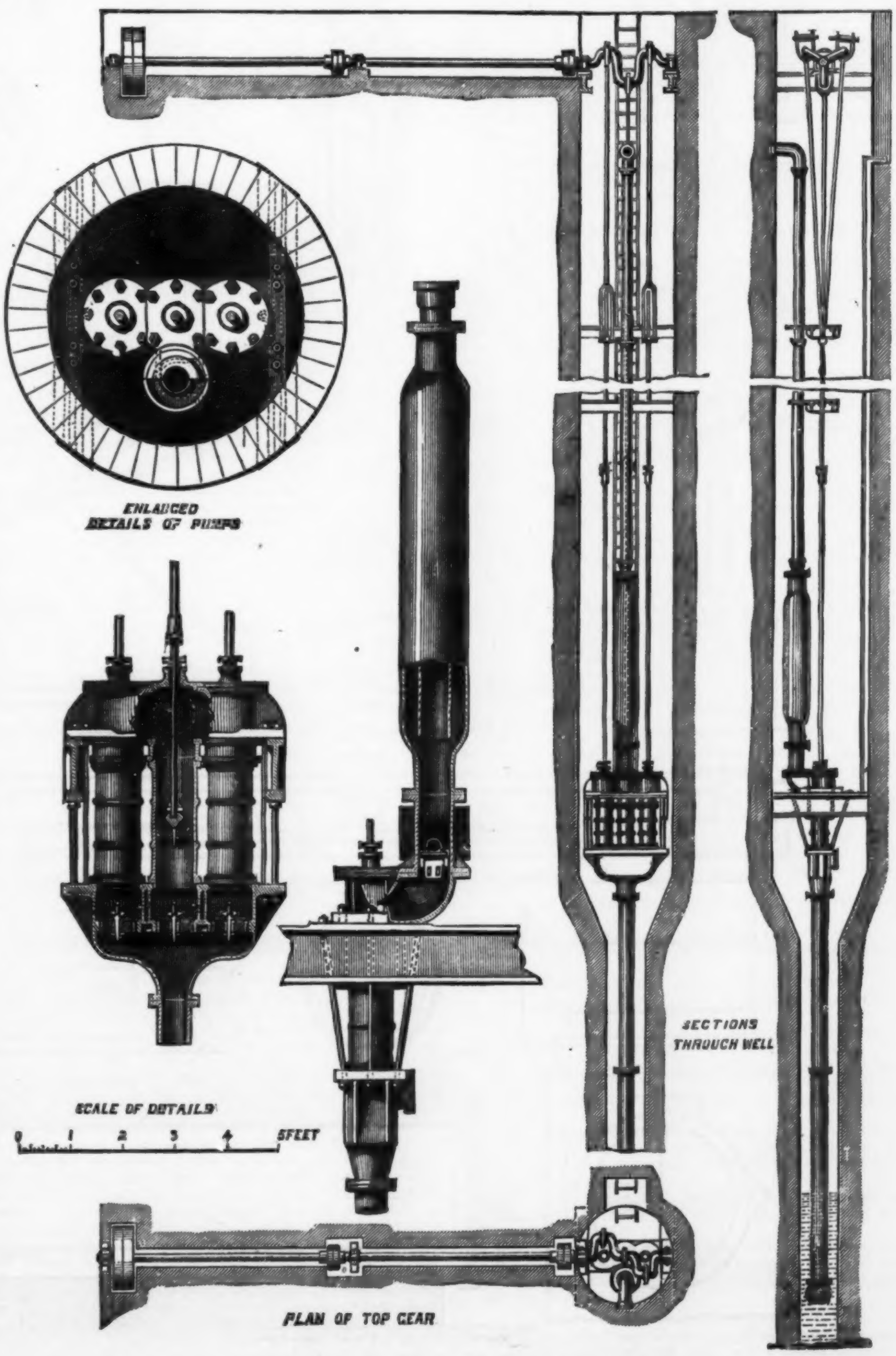
*This inventor appears to have copied, substantially, the American invention of J. H. Ellis, Springfield, Vt., which was fully illustrated and described in the SCIENTIFIC AMERICAN, Feb. 4, 1871, and January, 1872.

THREE-THROW PUMPS.

A TOUR of inspection through the country districts of Great Britain would reveal an astounding state of affairs as regards the water supply of rural towns. Although much has been done and is still being done to furnish ample quantities of good water to our cities, very little inde d has yet been effected in this direction in towns having small populations. So much has been said on the subject of late, however, that exertions are being now made in many directions to supply good water to those who have had previously to rely on pumps and wells, furnishing water of a very dubious quality at the best of times.

Andover, in Hants, supplies an instructive example of what may be effected in this way at a small outlay, when judicious measures are adopted. Until very recently Andover had no water works of any kind. The population of the town is 5,700. Not long since a limited company was formed to supply water. Mr. Tanner, of Colchester, took the contract for the work. The first step consisted in sinking a well 5ft. in diameter and 70ft. deep. A bore hole, 15in. diameter, was then driven to a further depth of 65ft. The whole depth of the well is thus 135ft. Close to the side of first well is a second, 70ft. deep, which is connected with the first by a culvert. From the side of the second well adits have been driven to increase the supply of water and provide storage. The wells have been driven from top to bottom in pure chalk, no other material of any kind having been encountered.

In the first-mentioned well is fixed a set of three-throw pumps, by Messrs. Hayward Tyler and Co., of London and Luton. The barrels of the pumps are 9in. in diameter, the stroke being 24in. They are of gun metal, the top and bottom chambers being of cast iron. The pumps are so arranged that, should it be necessary at any time to lower them in the well because of the water falling permanently, this can be done without altering the position of the girders which support them. The bottom chamber and barrels are supported from the girders by means of long bolts, and the upper parts of the barrels are so arranged that a cast iron lengthening piece of any required length can be inserted, the supporting bolts and piston rods being lengthened in proportion. Thus the girders and upper chambers of the pumps would remain in their original position while the working barrels are lowered to the required depth. The piston rods are of copper; the buckets and valves are of gun metal, with leather faces of the butterfly type, the central flat bolt or stay being of wrought iron. This system has been found by experience the best for wells of moderate depth. All the valves are accessible by means of doors. The pumps are driven by a wrought iron three-throw shaft, making between fourteen and fifteen revolutions a minute, and the pumps deliver about 5000 gallons an hour. The present lift is only about 60ft., but the work is so arranged that this can be increased if it should be found needful to deepen the well. The pumps were constructed and fixed



ENGLISH THREE-THROW PUMPS.

by Messrs. Hayward Tyler and Co., under the instructions of Messrs. Russ and Minnis, Civil Engineers, Westminster. The general design of the work is due to the superintendent engineers, while in various details Messrs. Hayward Tyler and Co. were allowed to follow the designs which they have adopted from their own experience.

In erecting small works much trouble is often encountered in providing the requisite motive power, not only the first cost of an engine and boiler having to be incurred, but also the expense of a regular attendant. The difficulty has been very ingeniously got over at Andover, the pumps being driven by a belt from Messrs. Hawkins' steam saw mill close by.

Our engravings give a section of the well, showing the mode of fixing the pump. The whole design is very creditable to the engineers, who have availed themselves of every favorable condition which presented itself.

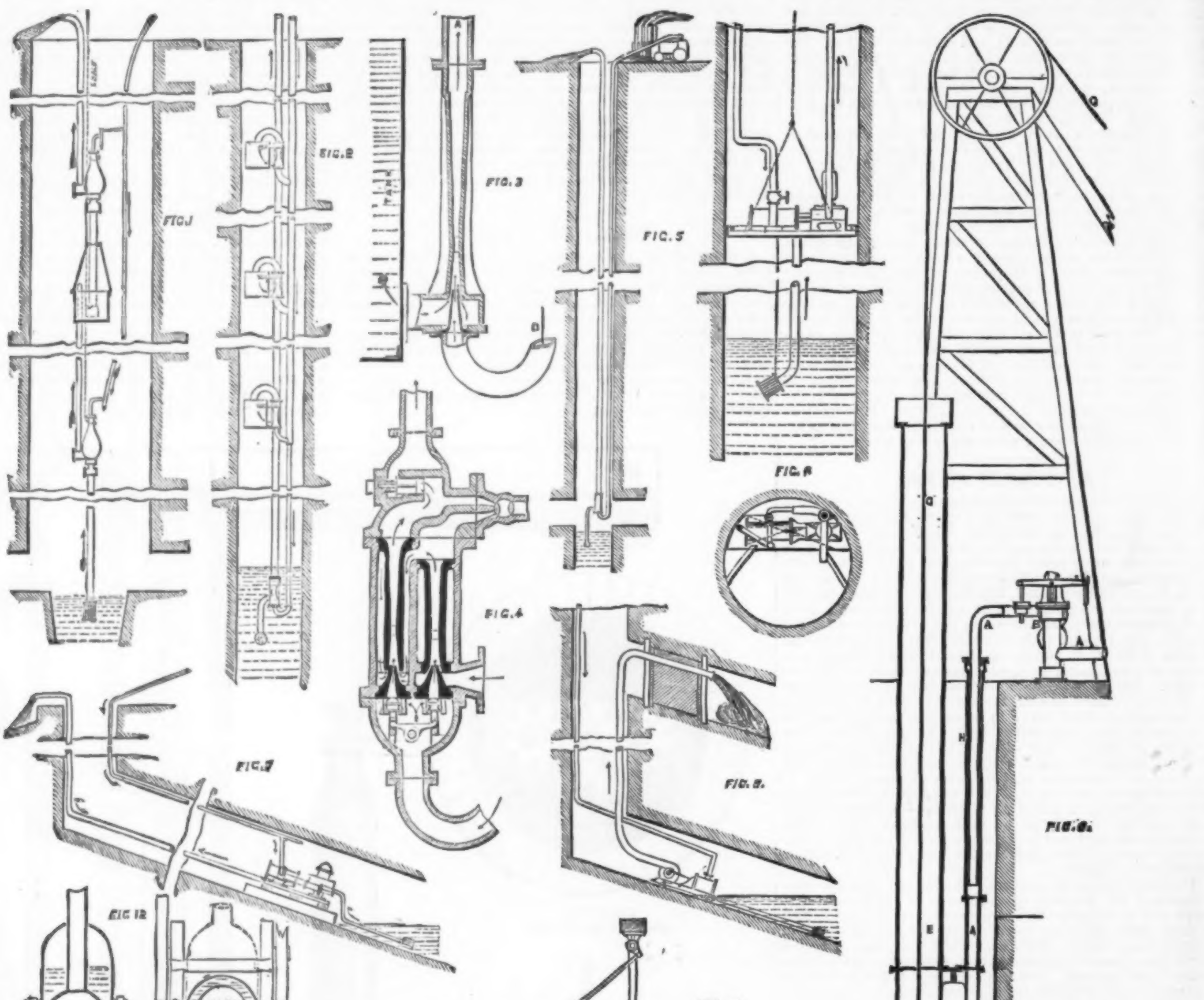
MECHANICAL APPLIANCES FOR MINE ACCIDENTS.

By CHARLES HAWKSLEY and EDWARD B. MARTEN.*

IN considering the general character of the special mechanical appliances best adapted to the purpose, the following requirements must be steadily kept in view: (a) Ease of transport; (b) adaptability to various situations; (c) rapidity of erection; (d) duplication and interchangeability of parts; (e) non-liability to derangement; (f) facility for repair.

* Read before the Institution of Mechanical Engineers.

The machinery and apparatus which it is most desirable to provide is principally: (1) Water-raising apparatus, for dealing with large quantities of water in a short time. (2) Portable boilers with fittings and steam pipes complete for promptly and efficiently supplying with steam at high pressure the pumping and other machinery; the boilers to be capable of being readily coupled together by interchangeable pipes, and to be prepared for transit by railway and over rough mining roads. (3) Air-compressing apparatus, for keeping back rising water, and enabling the mine to be entered before ventilation has been restored. (4) Air locks, with provision for quickly fixing them in the headings. (5) Ventilating apparatus, for promptly restoring ventilation after an explosion. (6) Temporary winding apparatus, for quickly replacing the winding gear over a pit when destroyed



MECHANICAL APPLIANCES FOR USE IN CASE OF MINE ACCIDENTS.

by an explosion, or to establish additional means of communication with the mine. (7) Diving apparatus, generally adapted for penetrating long levels under water. (8) Temporary workshop, fitted with complete sets of the tools likely to be needed. Through the kind assistance of several makers of the different kinds of machinery referred to, the writers are enabled to present descriptions and drawings of a few of the mechanical appliances which appear suitable for meeting the necessities of mine accidents.

It is well at the outset to note that such apparatus must not be judged by the ordinary rules of durability and economy in working, as the great object to obtain is handiness, portability, ease in putting together, and the greatest effect in the shortest time. It has to be noted that in colliery districts the source of power—coal—is readily obtainable, and the chief point to be considered is how to extract and apply that power with the greatest rapidity and efficiency; hence it appears that classes of water-raising apparatus which are not in favor where permanent and steady work are required, may be most suitable for the purpose under consideration.

THE PULSOMETER.

The Pulsometer (American), for example, has the advantage of needing only a steam pipe and delivery pipe; it may be lowered into water, and occupies but small space, and when being lowered requires only the addition of extra steam and delivery pipes at the top of the shaft. When the depth is great, several of these pumps can be placed in succession. The pulsometer, the construction of which has been illustrated in the SCIENTIFIC AMERICAN, is an instrument for applying the pressure of the steam directly upon the water to be lifted, the only working parts being the valves, and a small ball to direct the steam into the chambers alternately. The ball is self-acting, being drawn over by the increased velocity of the steam at the moment of the formation of the vacuum. An air-vessel to reduce the shock completes the apparatus, Fig. 1.

THE STEAM EJECTOR.

The ejector, another form of instrument for raising water by the direct application of steam without the intervention of moving parts, can be used; and in Fig. 2 is shown an arrangement suggested for the purpose by those familiar with its use. Fig. 3 shows an enlarged view of the ejector, which operates in the same way as the well known injector, forcing the water up the column A by the effect produced by the superior velocity of the steam jet B. It has no working parts, but is simply provided with means of adjustment. With some forms of the ejector the height of the delivery is limited only by the steam pressure obtainable. The enlarged view, Fig 4, shows such an instrument, and Fig. 5 shows its application when lifting to a great height.

DIRECT-ACTING STEAM PUMP.

Some of the smaller forms of direct-acting steam pumps are capable of application on emergency, as shown in Fig.6, where one is suspended from the surface. The same pump is shown in Fig. 7, fixed in a heading to force the water to the top of the shaft, steam being supplied from the surface. Other pumps can also be used in a similar manner.

THE CENTRIFUGAL PUMP.

The centrifugal pump is principally available where the height of the lift is small, but would be useful where the water could be got rid of by pumping from a lower level of the mine to another level at no great height above it, as shown in Fig. 8.

THE WATER-SPEAR PUMP.

A form of pump which appears to be peculiarly well adapted for the purpose in view is shown in Fig. 9, where, instead of using wooden spears working within the pump to transmit the power of the engine, it is proposed by the designer to apply what may be termed a water spear by means of a pipe independent of the pump, and to attach the working parts of the pump to a capstan engine by a wire rope in such a manner that the rope remains attached whilst the pump is at work, and is always in readiness to hoist the working parts to the surface, where they could be replaced by a duplicate set in a few minutes. The power is intended to be supplied from the surface by a forcing engine, the simplest form of which is indicated in Fig. 10, and all the operations could be carried on from the surface, thus enabling the pumps to be worked in any situation under water. In this way would be obviated the difficulties and delays occasioned by changing buckets and valves through door-pieces, and by drawing spears, as often found necessary in the ordinary system of pump-work, especially where dirty water has to be lifted. The mode of working may be thus described—on the surface, near the pit, would be placed a forcing engine capable of supplying all the power required for pumping; this engine could be of the form shown, in cases where time was of every consequence, or, if circumstances permitted, some other form of portable engine in which advantage could be taken of expansion. A capstan engine would also be needed for lifting and lowering the pipes, and for changing the working parts of the pumps as occasion required. The hydraulic pump would be lowered into the pit, and pipes added as frequently as required, both to the large delivery pump-trees and to the hydraulic forcing pipe. If needed, the pumps could be lowered at once to the bottom of the shaft. Where the water has to be followed where it is lowered, telescopic pipes at the surface could be used, of sufficient length to allow the pump to descend 30 ft. or 40 ft. without change. Such a pumping plant is calculated to work with but few interruptions, and the whole of the operations could be performed on the surface with facility and despatch, and without the use of steam in the pumping shaft.

DOUBLE ACTING HYDRAULIC PUMP.

In Fig 11 is shown a double-acting hydraulic engine on the same principle, designed for use underground where power is available either from the column of the main pumps or from a forcing engine. The engine is shown in a horizontal position; but for draining "dip" and distant workings it may be mounted on wheels, and made to follow the water as it is lowered, or in its compactest form it may be slung upright for use in a vertical shaft. This pump differs from that shown in Figs. 9 and 10, in being double instead of single-acting, and in the valves being worked by means of water pressure, in one central valve box; and it is perhaps more suitable for working under very heavy pressures.

MOUNTED HIGH PRESSURE BOILER.

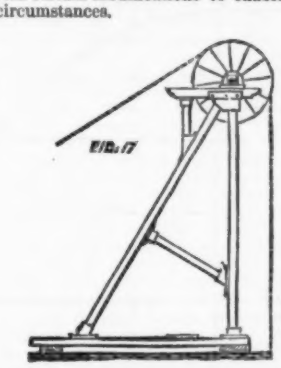
For the working of these and similar instruments to their better advantage, a greater pressure of steam is needed than is usually found at collieries; and, moreover, it is probable that the local boilers will be engaged in other work, so that special portable boilers will be required, those forms being selected which do the most rather than the best duty. In Fig. 12 is shown a vertical boiler with internal fire-box, intended to be worked at a pressure of 150 lb. per square inch. The boiler is mounted on wheels, and is provided with trunnions to enable it to be laid horizontally when traveling by railway. Another figure was given, representing a portable boiler on the locomotive principle, to sustain a pressure of 150 lb. to 200 lb. per square inch, and provided with wheels for traveling on roads, and also capable of being carried by railway without being dismounted.

COMBINED ENGINE, BOILER, AND AIR COMPRESSOR.

Whatever form of boiler is adopted, it is desirable that it be made of steel plates, with the object of attaining the greatest strength with the least weight; the boilers to be so fitted as to work separately or in groups. A portable air compressor, with engine and boiler attached, is shown in Fig. 13; and in Figs. 14 and 15 were indicated other well known forms of air compressors, with engines combined, such as those already referred to, but without attached boilers; a form of pump capable also of being used as an air compressor, and the same with arrangement of three combined, may be used where great pressure is needed. Air cylinders or other apparatus for enabling explorers to enter mines foul with choke damp should form part of the appliances provided.

AIR LOCK FOR MINES.

An air lock is shown in Fig. 16. The lock is of small size to facilitate fixing, and must be securely built into the heading in which it is to be used; the materials for so doing should be kept with the apparatus, together with air-proof sheeting in the event of the dam being porous. The boring apparatus, so ingeniously devised by Mr. Riches for use at the Tynewydd Colliery accident and described by him in a paper read at the last meeting of the Institution, would also be useful with certain modifications to enable it to meet a variety of circumstances.

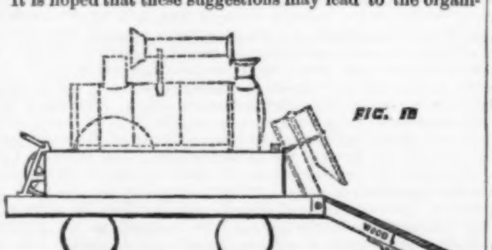


PORTABLE WINDING GEAR FOR MINES.

As the winding gear and head frames are often injured, or are too much employed to be spared for special use, portable winding gear and engines will often be needed; a portable frame so made as to be rapidly put together is delineated in Fig. 17. It is essential that the whole of the apparatus should be so arranged as to be easily carried on railway trucks, a convenient form of which for the purpose is shown in Fig. 18. Although the machinery and apparatus indicated in the drawings are for the most part doubtless well known to every mechanical engineer, illustrations have been given to make the references to them more clear.

It is necessary now to consider how the special appliances are to be provided and made available for the use of the mining community. It is not to be supposed that all that has been suggested can be accomplished without great consideration and much further information than could be obtained merely for the purpose of this paper, as to the special conditions of each mine, the needs of each past emergency, and the appliances that would have been best calculated to provide for them. The information so collected would lead to the designing of apparatus better adapted to the particular purposes in view than any now existing, nearly all of which has been constructed for working under other than the very exceptional conditions that obtain in the case of mine accidents.

It is hoped that these suggestions may lead to the organi-



zation of an association of mine owners for mutual protection against the calamitous results of mine accidents, by establishing a central depot, with, perhaps, a branch in each mining center, containing a complete collection of the requisite special machinery and appliances, ready for use at a moment's notice. The cost of providing and maintaining the establishment would be met by a general subscription by those to be benefited; but the establishment should be made to a considerable extent self-supporting, by suitable charges for the use of the apparatus. In connection with these depots, competent men should be provided for fixing and working the apparatus; a few to be permanently engaged, while the others pursue their ordinary work, attending at intervals for training, and being "at call" at other times when needed. Had such an establishment been in existence, no doubt many valuable lives might have been saved, and much pecuniary loss spared to those engaged in mining operations; and though it is not suggested that accidents of the distressing character of those that have so recently occurred could have been averted, their sad consequences might possibly have been lessened, had appliances of the kind referred to in this paper been available. But while it falls within the province of the mechanical engineer to point out the appliances best adapted to meet the necessities of the various classes of mine accidents, it must rest with the mineowners themselves to carry the suggestions into execution.

MR. RUSKIN'S APHORISMS ON DRAWING.

MR. RUSKIN has at length published the first part of his new book on art, under the title of "The Laws of Fiesole: a familiar treatise on the Elementary Principles and Practice of Drawing and Painting, as determined by the Tuscan Masters." It contains the following series of general aphorisms, which Mr. Ruskin wrote for a young Italian painter, as containing what was likely to be most useful to him, in briefest form:—

I.—The greatest art represents everything with absolute sincerity, as far as it is able. But it chooses the best things to represent, and it places them in the best order in which they can be seen. You can only judge of what is *best*, in process of time, by the bettering of your own character. What is *true*, you can learn now, if you will.

II.—Make your studies always of the real size of things. A man is to be drawn the size of a man, and a cherry the size of a cherry. "But I cannot draw an elephant his real size." There is no occasion for you to draw an elephant. "But nobody can draw Mont Blanc his real size." No; therefore nobody can draw Mont Blanc at all, but only a distant view of Mont Blanc. You may also draw a distant view of a man, and of an elephant, if you like; but you must take care that it is seen to be so, and not mistaken for a drawing of a pigmy, or a mouse near. "But there is a great deal of good miniature-painting." Yes, and a great deal of fine cameo-cutting. But I am going to teach you to be a painter, not a locket-decorator or medallist.

III.—Direct all your first efforts to acquire the power of drawing an absolutely accurate outline of any object of its real size as it appears at a distance of not less than twelve feet from the eye. All greatest art represents objects at not less than this distance, because you cannot see the full stature and action of a man if you go nearer him. The difference between the appearance of anything—say a bird, fruit, or leaf—at a distance of twelve feet or more, and its appearance looked at closely, is the first difference also between Titian's painting of it, and a Dutchman's.

IV.—Do not think, by learning the nature or structure of a thing, that you can learn to draw it. Anatomy is necessary in the education of surgeons; botany in that of apothecaries; and geology in that of miners. But none of the three will enable you to draw a man, a flower, or a mountain. You can learn to do that only by looking at them, not by cutting them to pieces. And don't think you can paint a peach because you know there's a stone inside, nor a face because you know a skull is.

V.—Next to outlining things accurately, of their true form, you must learn to color them delicately, of their true color.

VI.—If you can match a color accurately, and lay it delicately, you are a painter; as, if you can strike a note surely, and deliver it clearly, you are a singer. You may then choose what you will paint, or what you will sing.

VII.—A pea is green, a cherry red, and a blackberry black, all round.

VIII.—Every light is a shade, compared to higher lights, till you come to the sun; and every shade is a light, compared to deeper shades, till you come to the night. When, therefore, you have outlined any space, you have no reason to ask whether it is in light or shade, but only of what color it is, and to what depth of that color.

IX.—You will be told that shadow is gray; but Correggio, when he has to shade with one color, takes red chalk.

X.—You will be told that blue is a retiring color, because distant mountains are blue. The sun setting behind them is nevertheless further off and you must paint it with red or yellow.

XI.—"Please paint me my white cat," said little Imelda. "Child," answered the Bolognese professor, "in the grand school all cats are gray."

XII.—Fine weather is pleasant; but if your picture is beautiful, people will not ask whether the sun is out or in.

XIII.—When you speak to your friend in the street, you take him into the shade. When you wish to think you can speak to him in your picture, do the same.

XIV.—Be economical in everything, but especially in candles. When it is time to light them, go to bed. But the worst waste of them is drawing by them.

XV.—Never, if you can help it, miss seeing the sunset and the dawn. And never, if you can help it, see anything but dreams between them.

XVI.—"A fine picture, you say?"—"The finest possible: St. Jerome, and his lion, and his arm-chair. St. Jerome was painted by a saint, and the lion by a hunter, and the chair by an upholsterer."

My compliments. It must be very fine; but I do not care to see it.

XVII.—"Three pictures, you say? and by Carpaccio!"—"Yes—St. Jerome, and his lion, and his arm-chair. Which will you see?"—"What does it matter? The one I can see soonest."

XVIII.—Great painters defeat Death—the vile adorn him, and adore.

XIX.—If the picture is beautiful, copy it as it is; if ugly, let it alone. Only Heaven and Death know what it *was*.

XX.—"The King has presented an Etruscan vase, the most beautiful in the world, to the museum of Naples. What a pity I cannot draw it!"

In the meantime the housemaid has broken a kitchen teacup; let me see if you can draw one of the pieces.

XXI.—When you would do your best, stop the moment you begin to feel difficulty. Your drawing will be the best you can do; but you will not be able to do another so good to-morrow.

XXII.—When you would do *better* than your best, put your full strength out the moment you feel a difficulty. You will spoil your drawing to-day; but you will do better than your to-day's best to-morrow.

XXIII.—"The enemy is too strong for me to-day," said the wise young general. "I won't fight him; but I won't lose sight of him."

XXIV.—"I can do what I like with my colors now," said the proud young scholar. "So could I at your age," answered the master; "but now I can only do what other people like."—*The Architect.*

CORK trees at Sonoma, California, from seed twenty years ago, are now twenty-five feet high, while sheets of cork an inch and a quarter thick were taken off last year. It will not stand the winter, even in our middle states.

LESSONS IN MECHANICAL DRAWING.

By PROF. C. W. MACCORD.

Second Series, No. XVIII.

On the Screw Propeller, Continued.

It was remarked that the term "expanding pitch" is in itself indefinite, since the pitch of a surface composed of true helical elements may vary at different distances from the axis, in which case we have "radial expansion," of which we have just been treating; or the helices themselves may have an increasing pitch, when we shall have what is called "axial expansion," which comes next in order.

It is clear that the most simple surface having this peculiarity is one which may be generated by a right line perpendicular to the axis, rotating uniformly but advancing with a varying velocity; thus every point in the generatrix describes a helix of increasing pitch, the helices lying on different cylinders, but the pitch with its variations being the same in all.

Such a helix may be traced upon a cylinder while rotating uniformly, by a point which travels in the direction of an element with an accelerated velocity; and will develop, when the cylinder is unrolled into a plane, into a curve, of which the form will obviously depend upon the rate of acceleration, as well as upon the actual velocity of the tracing point. In drawing, it will be found most convenient to construct the development first, and afterward determine the form which it will assume on rolling the cylinder up again.

Before we can do either, we must know the law by which the motion of the tracing point is governed. The case which we will first consider, and the one most frequently met with, is that in which a propeller is said to have a uniformly increasing pitch; which is usually specified in the following manner:—Let us suppose for instance that the screw is 18 ft. in diameter, and limited by two planes perpendicular to the axis; then, the generatrix being also perpendicular to the axis, the blade will be bounded by two elements, appearing in the end view as radial lines; and let these planes be 36 inches apart; then we may be told that the *entering* pitch is 24 ft., the *mean* pitch 27 ft., and the *leaving* pitch 30 ft. In other words, the pitch increases 6 ft. in a length of 36 inches, measured in the direction of the axis, being least at the leading and greatest at the trailing edge. And the pitch is called "uniformly increasing," which expression is in itself rather ambiguous, and we must first of all settle upon the meaning to be attached to it. The source of this ambiguity will be best seen by considering a single helix, traced upon a cylinder rotating at a given uniform rate, by a marking point moving along in contact with it. By the conditions above stated, this point, at first travelling at a rate which would carry it 24 feet while the cylinder makes one revolution, increases its speed so that, when it has gone 3 ft., its rate is such that it would travel, if then allowed to go on uniformly, 30 ft. in the same time. And it might be made to move so that it would gain 6 ft. in its rate of travel, for every 3 ft. of actual advance; in other words, so that its velocity should be proportional to the distance travelled. In this case, equal increments of speed being gained in travelling equal distances, it sounds very plausible to say that the pitch increases uniformly.

But we may so move the marking point that it shall receive equal increments of speed in equal *times*, and under this condition, too, its velocity may be so regulated that it shall increase from 24 ft. to 30 ft. during the revolution, in advancing 36 inches as stipulated above. And it is clear that the law of the motion in this case is quite different from that in the preceding one. For there, the point would gain 3 ft. in going the first eighteen inches, and as much in going the second eighteen; but as the velocity is continually increasing, it would travel the second eighteen inches in less time than it required to travel the first; in regard to time, then, the rate of acceleration is not uniform, but is itself accelerated.

Now, the accepted definition of uniformly accelerated motion is in accordance with this second assumption, that the moving point receives equal increments of velocity in equal times. We shall, therefore, consider the "helix of uniformly increasing pitch" to be one that would be traced by a point thus moving upon a cylinder revolving uniformly. It will be clear that if a body be acted on by a constant force, its motion will be thus uniformly accelerated: for if, say in one second, the force would impart a certain velocity to the body originally at rest, it would impart an equal additional velocity during the next and each succeeding second, so that at the end of two seconds the velocity would be doubled, at the end of three seconds it would be trebled, and so on. Gravity, within small limits near the surface of the earth, is practically such a constant force; if then, as in what is known as Morin's apparatus, a vertical cylinder covered with paper be made to rotate uniformly by means of clockwork, and a weight carrying a pencil be allowed to fall freely beside it, the pencil will trace upon the paper a helix of uniformly increasing pitch, according to our definition. The paper being unwound, we shall have a curve, the form of which will depend upon the diameter and the velocity of the cylinder, as well as the speed of the falling weight. The latter, in the apparatus just mentioned, is, of course, always the same, and too great to be satisfactorily followed by the eye as it is traced. But the force of gravity may in effect be reduced; so that the actual velocity shall be as small as we please, while the motion is still uniformly accelerated. This is done in what is known as Attwood's machine, which consists substantially of nothing more than a pulley, over which runs a thread to which are attached two equal weights. If now a small weight be placed upon one of these two, the equilibrium is destroyed, and the gravity of the small weight sets the whole in motion, with a reduced velocity. Thus, if the two original weights be each $7\frac{1}{2}$ pounds, and the third one weighs one pound; then, disregarding the pulley, this one pound has to move sixteen pounds, which it will do with one sixteenth the velocity with which it would fall by itself. A body falling freely will travel about sixteen feet in the first second; in the supposed case then the weights will move only one foot in that time. We may, as shown in Fig. 117, attach a pencil to the falling weight, and allow it to make its record on a vertical cylinder. In Attwood's machine the movable weight is a long bar, which may be caught and thus removed at any desired point in the fall by a fixed ring through which the weight passes; after which the motion becomes uniform. By thus combining this with Morin's apparatus, as shown in the figure, it would seem that the laws of the motion might be more satisfactorily illustrated than by either alone; but, strangely enough, it never has been done, as far as our knowledge extends.

Be that as it may, in order to draw our propeller, we must be able to draw the helix, which, as before remarked, is most readily done by first drawing its development, And the construction of this curve requires a little preliminary study of the law of the accelerated motion, and of the modes of representing it; which we will take up at the very beginning, for the benefit of those of our readers who may not have given the matter attention.

When a body moves uniformly, the space passed over varies as the product of the time and velocity: thus, a body moving at the rate of five feet per second will travel fifty feet in ten seconds, one hundred feet in twenty seconds, and so on. Now, we may represent the velocity by a right line of definite length; thus, if a line one inch in length be taken to represent a velocity of one foot per second, a line two inches long will represent a velocity twice as great; and in like manner intervals of time may be represented by right lines, the absolute lengths being arbitrary in both cases. It will then be seen that, if we represent the time by a line in one direction, and the velocity by another at right angles to it, the space passed over will properly be represented by the rectangle of which these lines are the two sides, since its area is the product of its length and breadth.

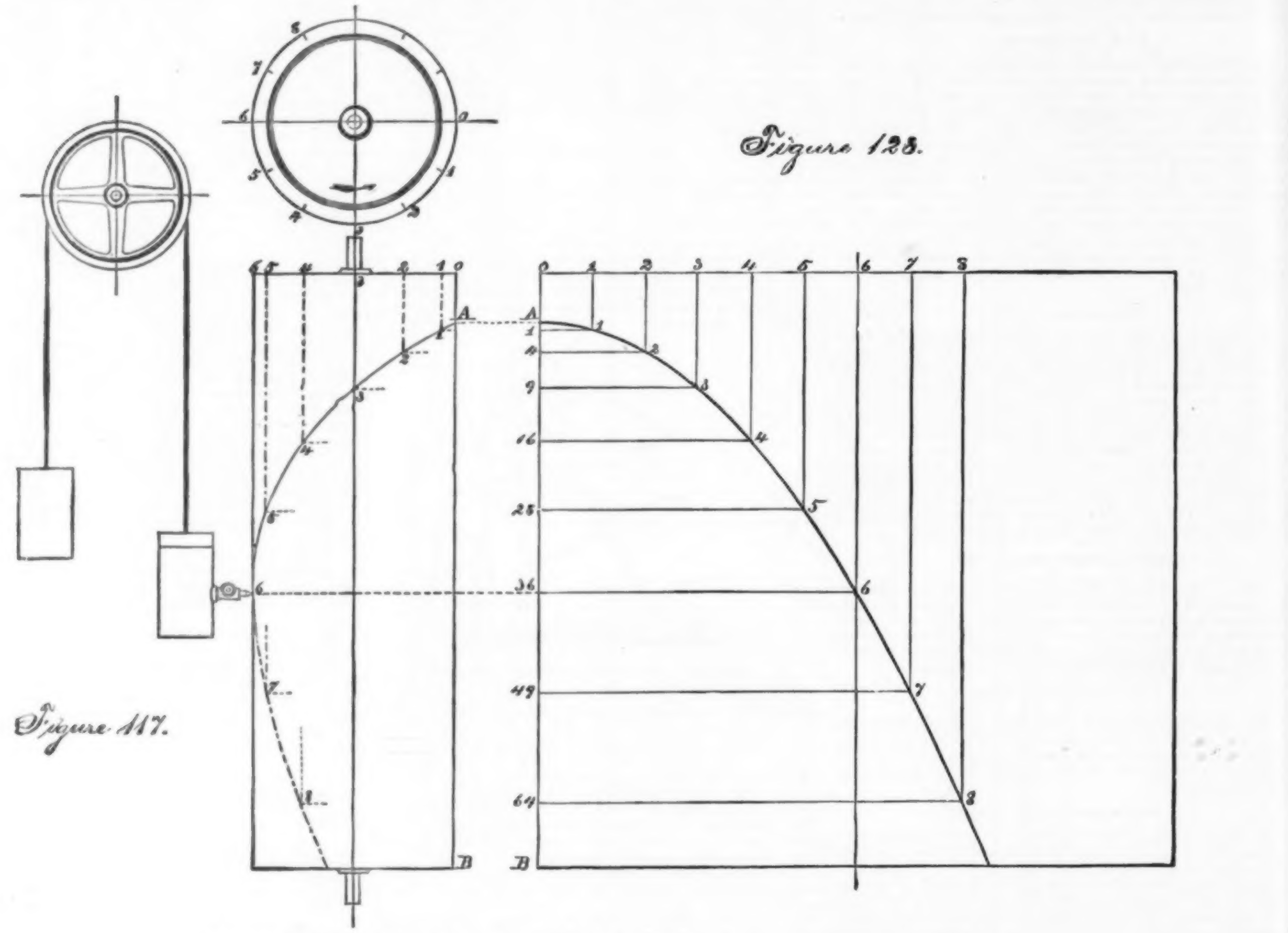


Figure 117.

Figure 128.

LESSONS IN MECHANICAL DRAWING.—SECOND SERIES.—No. 18.

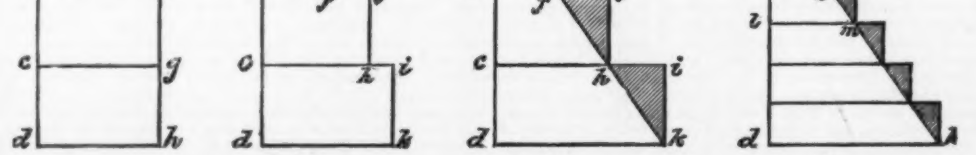


Fig. 118. Fig. 119. Fig. 120. Fig. 121.

LESSONS IN MECHANICAL DRAWING.—SECOND SERIES.—No. 18.

Thus in Fig. 118, let *a b*, *b c*, *c d*, represent equal intervals of time, and *a e* the velocity of a body moving uniformly; then the rectangle *a f* will represent the space passed over in the first interval, *b g* that in the second, *c h* that in the third.

Now, in Fig. 119, let the times, *a a*, *b c*, *c d*, be equal as before; and let the velocity during each interval be uniform, but greater during the second than during the first, and during the third greater still, as indicated by the lines *a e*, *b g*, *c i*. Then the space passed over in the first interval will be *a f*, in the second *b h*, in the third *c k*, the whole area of the figure *a e g k d*, or the sum of these rectangles will be the space passed over in the line *a d*.

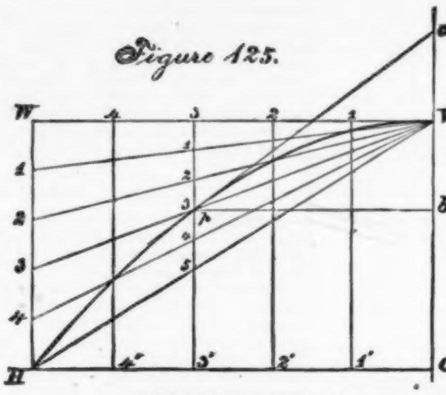


Figure 125.

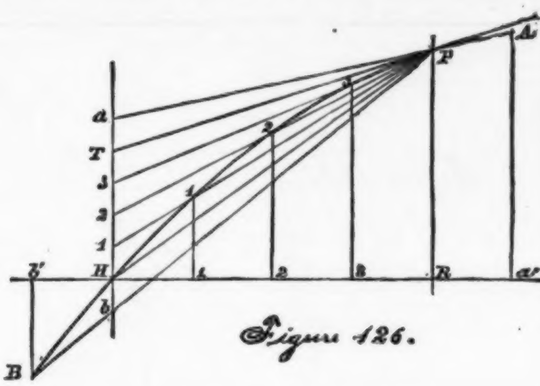


Figure 126.

LESSONS IN MECHANICAL DRAWING.—SECOND SERIES.—No. 18.

In Fig. 120, the case is the same as in Fig. 120, except that at the end of the first interval *a b*, the body receives an increment of velocity *f g*, equal to *a e*, and at the end of the second interval *b e*, another increment *h i*, also equal to *a e*. It will be seen that the triangles *a e f*, *f g h*, *h i k*, are similar and equal, so that *a f h k* will be a right line; and that the sum of these triangles is the difference between the whole area of the figure *a g k d* and the triangle *a d k*.

Next, in Fig. 121, let the whole time, *a d*, be the same as before, but the intervals, *a b*, *b c*, etc., into which it is subdivided, be only half as great. Let also the velocity, *a e*, during the first interval be only half what it was before, and the increments *f g*, *h i*, etc., be reduced in the same proportion. We now see that if, from the whole area representing the space passed over, we subtract the sum of the small triangles *a e f*, *f g h*, etc., there will remain the same triangle, *a k d*, as in the preceding case. There are twice as many of these triangles, but each one is only a quarter as large, so that their aggregate area is only half what it was.

Were we to continue this process, it is evident that the difference between the triangle, *a d k*, and the whole area representing the space would diminish, very soon become inappreciable, and ultimately disappear, when the intervals *a b*, *b e*, etc., become infinitely small.

In that case the initial velocity, *a e*, would disappear also; that is to say, the body starts from a state of rest, and if acted on by a constant force capable of imparting to it a velocity, *b f*, in a time *a b*, that force will in equal times generate equal increments of velocity, and the phenomena of its motion are accurately represented by the right-angled triangle, *a d k*, whose area will be the space traversed in the time, *a d*, if *d k* represents the final velocity.

We observe, then, that the velocities are proportional to the time. That is to say, if a body moving from a state of rest acquire at the end of any stated interval of time a given velocity, it will at the end of another equal interval be moving with twice that velocity, at the end of the next with three times the velocity, and so on; thus, *a c* is twice *a b*, and *c h* is twice *b f*; also, *a d* is twice *a l*, and *d k* is twice *l m*, and the same will clearly be true from the similarity of the triangles, whatever the magnitude of the intervals.

We also notice that the spaces are proportional to the squares of the times: in other words, if a certain space be traversed in a given interval, from a state of rest, then in twice that interval the body will travel four times as far, in three times the interval it will go nine times as far, and so on. For the areas of the similar triangles are proportional to the squares of their homologous sides; thus, *a c* being twice *a b*, we have

$$\text{area } ach : \text{area } abf :: ac^2 : ab^2 :: 4 : 1$$

In Fig. 122, the triangle has its altitude divided into six equal parts at the points numbered 1, 2, 3, etc., in the column *T*, each subdivision representing an interval of time. In the sloping column *V*, are marked the velocities, 2, 4, 6, etc., acquired at the end of each interval. It will be clear that the actual values of these velocities might be made either greater or less, provided that their *relative* values are not changed, so that the series is in fact the same as 1, 2, 3, etc., as marked in the column *T*; that is to say, the velocities are proportional to the times, as above stated. In other words, since the altitudes represent times, and the bases represent velocities, which are things of different kinds, we may use different scales in measuring them.

Now, the velocity at the end of the first interval being 2, we see that the area of the triangle will be 1, if the altitude be also called 1. The body of it moved uniformly during the next interval would traverse a space of 2; but to this we must add 1, the space due to the increase of velocity during the second interval, at the end of which its rate will be 4. Thus the distances traversed in the successive intervals, as marked in column *D*, will form the series of odd numbers 1, 3, 5, etc. From which we obtain the total spaces by adding each of these in order to the sum of the preceding ones, thus,

$$1 + 3 = 4, \quad 4 + 5 = 9, \quad 9 + 7 = 16, \text{ etc.},$$

which results, as it ought to, in forming the series of the squares of the successive integers, 1, 4, 9, 16, 25, 36, marked in column *S*.

We shall now be able to determine the form of the curve traced on the vertical cylinder by the pencil in Fig. 117. Let the cylinder be cut along a vertical element, and developed into the plane *A B C D*, Fig. 123. From *A*, set off on the horizontal line *A D* the equal divisions *A*–1, 1–2, 2–3, etc. As the cylinder is revolving with uniform velocity, these divisions will correspond to equal divisions of time. On the vertical line *A B*, mark points whose distances from *A* are in the proportion of the series 1, 4, 9, 16, etc., that is, proportional to the squares of the times 1, 2, 3, etc. Through these points draw horizontal lines, intersecting the vertical lines drawn through the points of subdivision on *A D*, as shown. From the curve drawn through the points of intersection will be that traced by the pencil in falling from rest at *A*, if the adjustment be such that it shall fall from *A* to 1, in the time occupied by the cylinder in turning through the angle measured by *A* 1 on the circumference *A D*.

It will be seen that this curve is always a parabola whose vertex is *A* and axis *A B*, since the abscissas A 1, A 4, A 9, are proportional to the squares of the ordinates 1–1, 2–4, 3–9. But in order to determine the scale on which the parabola is drawn, and to determine the exact curvature in any given case, we must know the diameter and velocity of the revolving cylinder, and also the velocity of the pencil.

And these data, if determined by actual observation in the use of such an apparatus, may, clearly, be expressed in precisely the same form as that in which the conditions of our proposed screw propeller were stated. Thus, if it be noted that in falling a distance of 36 inches the velocity increases from 24 feet to 30 feet per minute, and the cylinder is turning at the rate of one revolution per minute, we shall have exactly the case assumed for illustration: and it obviously makes no difference whether these be the actual velocities or not: if the relative velocities of the pencil and the cylinder remain the same, we can from this information construct the curve on a cylinder of any given size.

The mode of operation is shown in Fig. 124, in which as in the preceding diagram *A B C D* is the developed surface, *A D* being the rectified circumference, laid off by any convenient scale.

By the same scale set off *D E* — 30 feet, and draw *A E*; this is clearly the development of the helix which would be traced on the cylinder were the propeller a true screw of 30 feet pitch, and must therefore be tangent to the development of the curve actually traced at the point where the pitch is the same. Draw any horizontal line *H K*, cutting *A E* at *H*, which will then be that point of tangency. Parallel to *H K*, and 36 inches above it by the same scale, draw L M;

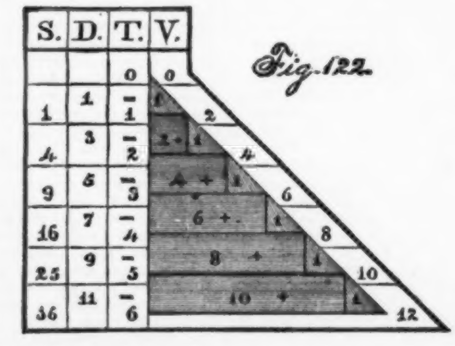


Fig. 122.

then by the conditions, the curve which when crossing *H K* at *H* has a pitch of 30 feet, must, when crossing *L M*, have a pitch of 24 feet. Set off *D G* — 24 feet by the scale, and draw *A G*, which would be the development of a true helix of the pitch named, and therefore indicates the direction of the curve at its intersection with *L M*. The next thing is to determine that point of intersection: in order to do this, use is made of another result of the law of the motion, which will be clear by reference to Fig. 122. We see that the area, 36, of the triangle 0–6–12, is half that of a rectangle having the same base and the same altitude, so if we take the triangle 0–4–8, whose area 16 represents the space through which the body moves from rest in 4 units of time, we see that it is just half that which would have been traversed in the same time by a body moving uniformly with the final velocity, 8. Or, it is the same as though the body had moved uniformly during the same time, 4, with the *mean* velocity, 4. And this last holds true, whether the body move from rest or not, if the rate of acceleration be unchanged. For example, at the beginning of the fourth interval of time, the velocity is 6, at the end it is 8, and the space traversed during the interval is 7, just what it would be had the motion been uniform, with the mean velocity, 7. So again, at the end of the sixth interval the velocity is 12, at the beginning of the fifth it is 8, and the space traversed during the two intervals is 20, as it would have been in the case of uniform motion for the same time with the mean velocity, 10.

We see then that the time occupied in traversing a given space, the initial and final velocities being known, is the same as that required to traverse the same space at the mean rate, supposing the motion in the latter case to be uniform.

This will enable us to find the required point on *L M*, thus; the initial pitch being 24 feet, the final 30, the mean is 27: therefore set off *D F* = 27 feet by the scale, draw *A F*, and parallel to it draw *H N*, cutting *L M* in the required point *P*. Through *P* draw a parallel to *A G*, and it will be tangent to the curve at that point, since it is there required that the pitch shall be 24 feet.

Now draw *P R* perpendicular to *H K*; then by comparison with Fig. 123 it will readily be seen that *H R* will represent the time occupied in traversing the space *P R*. Now, the times are proportional to the velocities, which at the points *P* and *H* are as 24:30, or as 4:5. If then we set off on *H K* the distance *H O* = 5 × *H R*, it is clear that the vertical line *O S* will be the axis of the parabola. *O S* cuts *E A* in *S*; and since *E A* is tangent to the parabola at *H*, we have *H O* an ordinate, *H S* the *tangent* (meaning the definite portion intercepted between the point of the contact and the axis), and *O S* the *subtangent*. It is a property of the parabola that the subtangent is bisected at the vertex: hence if we bisect *O S* in *V*, that point is the vertex.

And this again agrees, as it ought to of course, with the previous deductions from Fig. 122. For now *V O* represents the whole space traversed in acquiring the final velocity or pitch of 30 feet; and it is obvious on inspection that in the case of uniform motion at that rate, as represented by the line *A E*, the distance traversed in the time *H O* would have been *O S*, that is, twice *V O*.

We have now all the data required for drawing the parabola, by the method shown in Fig. 125, where *V* is the vertex, *V O* the axis, *H* a point in the curve. Draw *V W* perpendicular, and H W parallel, to V O. Divide these lines into the same number of equal (or proportional) parts, numbering them as in the diagram. Through the points of division on V W draw parallels to V O, as 1–1′, 2–2′, etc., and through V draw lines to the points of division on H W, as shown. Then the intersections, as of V–1 with 1–1′, of V–2 with 2–2′, and so on, will be points on the parabola. If desired, greater accuracy in drawing in the curve may be ensured by drawing tangents at the points thus determined, which is readily done by the aid of the property above mentioned, that the subtangent is bisected at the vertex. Thus, *p b* is the ordinate at *p*: prolong *O V*, make *V a* = *V b*, then *a p* is the tangent at *p*. In practice, it is not necessary to draw *p b* at all, but merely to set off V *a* = *p* 3, since *p* 3 = *V b*. It will be observed that the parabola may be produced, as far as we wish, by substantially the same process. Suppose, for instance, that in Fig. 125 the point *p* had been given instead of *H*. By subdividing *V* 3 and *p* 3 into three equal parts each, we should have found the two points between *V* and *p*, just as was done in the diagram by the original construction. We should then have only to set off other spaces on 3–3′ below *p*, equal to those above that point, draw lines from *V* through the points thus marked, and intersect them by vertical lines 4–4′, *W H*, whose distances from each other are equal to the subdivisions of *V* 3, in order to prolong the curve *V p* to *H*: and in like manner it may be prolonged to any desired extent.

The distance *V O* in Fig. 124 may be readily calculated; for in connection with Fig. 122 it was seen that the spaces traversed in the successive intervals, counting from zero, are in the proportions of the odd integers, 1, 3, 5, 7, 9, 11, etc. The interval during which the space *P R* is traversed is the fifth, therefore the corresponding integer is 9, and *P R* itself is 36 inches, giving $\frac{36}{9} = 4$ inches for the space traversed in the first interval. Then, as the total space increases with the square of the time, we have V O = 4 × 5^2 = 100 inches.

Now it may be said that since, under the stated conditions, our propeller is limited by the two planes *L M*, *H K*, we have to do only with the portion *H P* of this curve, and it is not necessary to pursue it to the vertex. Very well; if any of our readers is so devoid of interest in the subject that he does not care what the curve is, nor wish to take the trouble to find out where it leads to, he is welcome to skip as much of the preceding as will leave him in a satisfactory state of ignorance. There are, we take it, a sufficient number of others who wish to cover the whole ground; and if we have been the means of giving them any assistance, we are well contented.

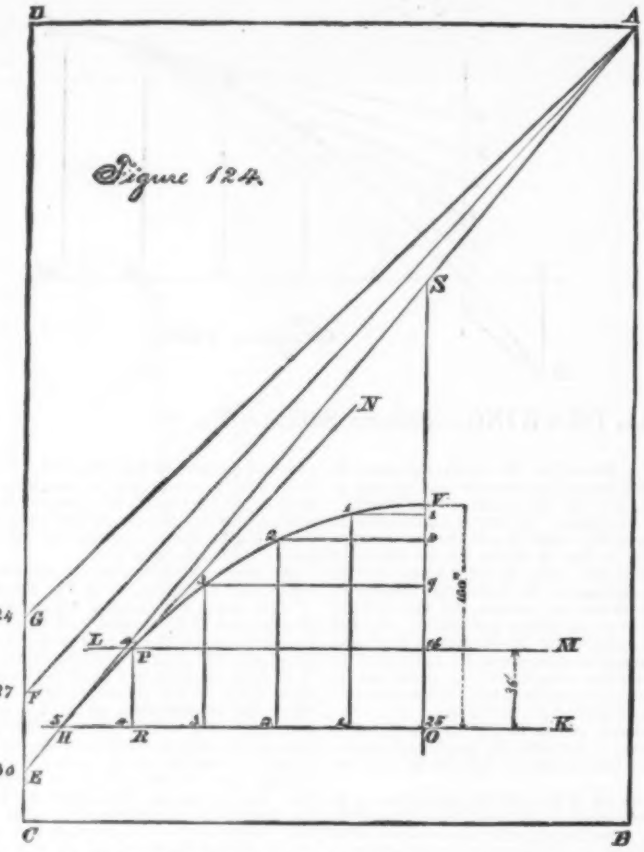
But it may be that the drawing is on so large a scale that it is impossible to trace the parabola to the vertex; and, indeed, now that we know how to do it, it may be freely stated that it is not by any means always necessary that it should be done.

Under such circumstances, the method of drawing a portion of the parabola, shown in Fig. 125, will be found serviceable. It is supposed to be known, first, that *P T* is tangent to the required curve at *P*; second, that *P R* is parallel to the axis; and third, that the parabola is to pass through *H*. Draw *H T* parallel, and *H R* perpendicular to *P R*; subdivide these lines into the same number of equal parts, and draw through the points of division at *H R*, parallels to *P R*. Also draw lines from *P* to the points of division on *H T*, which will cut the parallels to *P R* in points of the curve. It is to be noted that the curve may be in this case also extended beyond *P* and *H*. Thus in the figure, *H b* is equal to one of the subdivisions of *H T*, and *H b′* to one of those of *H R*: then drawing *P b*, and producing it to cut the vertical through *b′*, we determine *B*, a point in the parabola. In precisely the same way, prolonging *H R* to the right and *H T* upward, we set off *T a* = *H b*, *R a′* = *H b′*, and draw *a P*, producing it to cut the vertical through *a′* in *A*, a point in the curve.

The points *P* and *H* of Fig. 126 correspond to those similarly lettered in Fig. 124, so that the direction of the tangent at *H* is known, as well as that of *T P*. Evidently this will always be the case in practice, since the actual pitch at some point, and the rate of increase, must be given; and then, the subdivisions of *H R* representing equal intervals of time, the tangents at the points 1, 2, 3, of the parabola may be drawn by setting off the pitches intermediate between *P* and *H*, to

the same manner as *D E*, *D F*, and *D G* were set off in the original construction of Fig. 124, for the purpose of determining the directions of the tangents at *P* and *H*. It may be pointed out that the extension of the curve in the manner explained in connection with Fig. 126 is not only useful as ensuring accuracy in the part *P H*, but in many cases essential, because the blade, if overhanging, may extend beyond the limits named in the statement of the conditions.

Having now constructed the developed curve, it remains only to wrap it back upon the cylinder, in order to complete the projection of the helix with increasing pitch. This



LESSONS IN MECHANICAL DRAWING.—Second Series.—No. 18.

operation having already been illustrated in Fig. 251, Lesson XXIX., 1st series, it is not worth while to repeat the explanation here. Its execution may serve as an exercise for the student preparatory to drawing a complete propeller of axially expanding pitch, which we shall discuss in the next lesson. Meantime, it will probably occur to our reader that, by means of a "guiding iron" of the proper form, the acting surface of the blade of a screw of this description may be struck up without a pattern, just as easily as a true helicoid, and that whether the generatrix be perpendicular or inclined to the axis.

HARDENING AND TEMPERING OF STEEL.

By JOSHUA ROSE, M. E.

NUMBER 3.

IN heating steel to harden it there arise many considerations, the principal of which are as follows:

As the steel becomes heated it expands; and if one part becomes hotter than another, it expands more, and the form of the steel undergoes the change necessary to accommodate this local expansion, and this alteration of shape becomes permanent. In work finished and fitted this is of very great consideration, and, in the case of tools, it often assumes sufficient importance to entirely destroy their value. If, then, an article has a thin side, it requires to be so manipulated in the fire that such side shall not become heated in advance of the rest of the body of the metal, or it will become locally distorted or warped, because, though there exist but little difference in the temperature of the various parts, the more solid parts are too strong to give way to permit the expansion; hence the latter is accommodated at the expense of form of the weakest part of the article. It does not follow, however, that the part having the smallest sectional area is the weakest when in the fire, unless it is as hot as the rest of the body. For example, suppose we have an eccentric ring, say ¼ inch thicker on one side than the other, and heat it midway between the thick and thin sides to a cherry-red; while those sides are barely red-hot, the part heated to cherry-red will be the weakest, and will give way most to accommodate the expansion, because the strength due to its sectional area has been more than compensated for by the reduction of strength due to its increased temperature. The necessity of heating an article according to its shape then becomes apparent, and it follows that the aim should be to heat the article evenly all over, taking care especially that the thin parts shall not get hot first. If, then, the steel is heated in the open fire, it may be necessary to take it from the fire occasionally, and cool it with water, and to so hold it in the fire that the thin part is least exposed to the heat. If the article is large enough the thin part may be covered, or partially so, during the first of the heating by wet ashes. If, however, the article is of equal sectional area all over, it is necessary to so turn it in the fire as to heat it uniformly all over; and in either case care should be taken not to heat the steel too quickly, unless, indeed, it is desirable to leave the middle somewhat softer than the outside, so as to have the outside fully hardened and the inside somewhat soft, which will leave the steel stronger than if hardened equally all through. Sometimes the outside of an article is heated more than the inside, so as to modify the tendency to crack from the contraction during the quenching; for to whatever degree the article expands during the heating, it must contract during the cooling. Whether the heating be done in the open fire or in a heating mixture, it must be done uniformly, so that it may often be necessary to hold the article, for a time, with the thick part only in the melted lead or other heating material; but in this case it should not be held quite still, but raised and lowered gradually and continuously, to ensure even heating.

The size of an article will often be an important element for consideration in heating it, because, by heating steel in the open fire, it becomes decarbonized; and it follows that, the smaller the article in sectional area, the more rapidly this decarbonization takes place. In large bodies of metal, the decarbonization due to a single heating is not sufficient to have much practical significance; but if a tool requires frequent renewal by forging, the constant reheating will seriously impair its value; and in any event it is an advantage to maintain the quality of the steel at its maximum. To prevent decarbonization for ordinary work, charcoal instead of coal is sometimes used; and where hardening is not done continuously it is a good practice, because a few pieces of charcoal can be thrown upon the fire and be ready for use at a few minutes' notice. Charcoal should be used for the heating for the forging as well as for that for the hardening. Green coal should never be used for heating the steel for the hardening, even if it is for the forging process; because, while the steel is being well forged, its quality is maintained, but afterwards the deterioration due to heating is much more rapid. A coke suitable for heating to harden should be made and always kept on hand. To obtain such a coke, make a large fire of small soft coal well wetted and banked up upon the fire; and with a round bar make holes for the blast to come through. When the gas is burnt out of the interior coal, and the outside is well caked, it may be broken up with a bar, so that the gas may be burned out of the outside, and then the blast may be stopped and the coke placed away ready for use at a moment's notice. Good blacksmiths always keep a store of this coke for use in taking welding heats as well as for hardening processes. It is desirable that the article be heated as quickly as possible so as to avoid decarbonization as much as possible. If an article has a very weak part, it is necessary to avoid resting that part upon the coal or charcoal of the fire; otherwise the weight may bend it, and in heating long slender pieces they should bed evenly in the fire or furnace, or, when red hot, the unsupported parts will sag. In taking such pieces from the fire, the object is to lift the edges vertically so that the lifting shall not bend them; and this requires considerable skill, because it must be done quickly, or parts will get cooled and will warp, as well as not harden so much as the hotter parts.

We now come to the cooling or quenching, which requires as much skill as the heating, to prevent warping and cracking, and to straighten the article as much as possible during the cooling process. The cooling should be performed with a view to prevent the contraction of the metal from warping the weaker parts; and to aid this, those parts are sometimes made a little hotter than the more solid parts of the article, the extra heat required to be extracted compensating in some degree for the diminution of sectional area from which the heat must be extracted. Water for cooling must be kept clean, and in that case it becomes better from use. It may be kept heated to about 100° Fahr., which will diminish the risk of having the article crack. Cracking occurs from the weaker parts having to give way to suit the contraction of other parts, and usually takes place in the sharp corners or necks of the articles, or through the weakest section; hence, in articles found to be liable to crack, such corners are made as rounded as possible. If the water is very cold, and the heat is hence extracted very rapidly from the outside, the liability to crack is increased; and in many cases the water is heated to nearly the boiling point, so as to retard the extraction of the heat. Since, however, the hardening of the steel is due to the rapid extraction of its heat, increasing the temperature of the water diminishes the hardness of the steel, and it is necessary to counteract this effect as far as possible, which is done by adding salt to the water, the steel hardening more thoroughly in the saline mixture. To assist the hardening, various ingredients are sometimes added to the water, such as fuller's earth, cyanide of potash, etc., which will be noted in connection with examples of hardening. All articles that are straight or of the proper form when leaving the fire should be dipped vertically, and lowered steadily into the water; and if of weak section or liable to crack or warp, they should be held, quite still, low down in the water until cooled quite through to the temperature of the water. If the article is taken from the water too soon, it will crack; and this is a common occurrence, the cracking often being accompanied by a sharp audible "click." Pieces of blade form should be dipped edgeways, the length of the article lying horizontally and the article lowered vertically and held quite still, because, by moving it laterally, the advancing side becomes cooled the quickest, and warping and cracking may ensue. Straight cylindrical pieces are dipped endwise, and vertically. When, however, the dipping process is performed with a view to leave sufficient heat in the body of the article to lower or temper the part dipped, the method of procedure is slightly varied, as will be explained in examples.

A TEN-INCH GAUGE RAILROAD.

THERE is now in operation in Massachusetts a steam railroad of 10 inch gauge. The projector of this novel enterprise is a young mechanic and engineer, who is evidently a man of courage and ability.

To show how narrow a track may be, and be practical and safe, with his own hands he constructed a railroad having but 10 inches width of track, from the elevated village of Hyde Park down to the depot. He also, with his own hands, constructed the cars to run on the track. In these he carried, in six weeks, over 3,000 passengers from the village down to the depot, without the slightest injury to anyone. There were several short curves on the way, and the track crossed the highway twice. The people of Billerica, wishing a road through their town from North Billerica, on the Boston and Lowell Railroad, to Bedford, a distance of 8½ miles, requested the projector, Mr. George E. Mansfield, to come and give the people a lecture on narrow track railroads. Some said, "It is a chimerical notion;" but others gave a helping hand and secured a movement so far as to get a petition for a charter from the legislature. The charter was allowed. Then the right of way was secured gratis the whole distance. Next the stock was subscribed. Then came the building of the road, which was completed by the 1st of September, so that cars passed with passengers over the entire route that day and secured the right of way. There are 11 bridges on the route, one over 100 feet long. The rail weighs 25 lbs. to the yard. The road is well built and equipped; one grade is 155 feet.

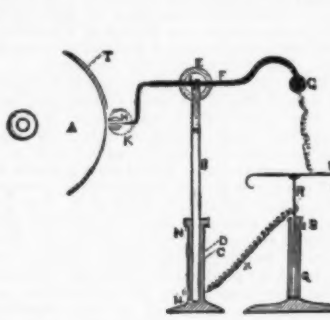
The cars and engines of the road will at once attract and fix attention. They are very well proportioned and make quite a handsome appearance. The engine is behind the tender and next the cars, so that, when the train moves, the car next the engine draws down upon and increases the adhesion of the engine to the track. Both engine and cars are constructed so as to be very near the ground, giving great advantages in regard to safety, also very little oscillation. The cars have an aisle with one seat on each side, in the same manner as ordinary cars have two seats. The length of the cars allows 30 seats, each person having a seat to himself. The cars are warmed by steam, are well ventilated, have closets, water-tank, all the modern improvements, Westinghouse brakes, etc. They weigh but 4½ tons, ordinary cars weighing on an average 18 tons. The road cost $4,500 per mile. The trains run about 20 an hour. Engines weigh 8 tons, and draw two passenger and two freight cars.

LIFTING A RAILWAY STATION.

CHEPSTOW Railway Station, England, was recently lifted bodily a height of 22 inches. Passengers have long experienced much inconvenience arising from the difficulty and danger of descending from or climbing into the carriages. This arose from the fact that the platform was but a few inches above the level of the rails. Some time back Mr. Lancaster Owen, engineer of the Great Western Railway, suggested by way of a remedy for the evil, the feasibility of lifting the station bodily and building it up from below. Chepstow Station comprises two stone buildings, one on either side of the line, built of native freestone, with dressings of Tintern Abbey stone, and its estimated weight about 150 tons. Each building is 56 feet long by 18 feet 6 inches wide, and 12 feet 7 inches high, with an overhanging roof of corrugated iron, on the platform side stretching out 7 feet or 8 feet, and is divided into the usual waiting-room and offices. Tenders were advertised for, and that of Messrs. Whalley and Pearse was ultimately accepted. The "lifting" process was commenced on Monday week. The building on the down platform has been first operated upon. The floor was taken up to facilitate the working of the jacks, but all the sashes and doors were left in their places, each opening having been securely strutted. Then holes were made through the building, about 2 feet under the string course, and in these holes were inserted baulks of timber, called "needles," to the number of eleven, their ends standing out a few feet on either side of the building. Fastened on the ends of these "needles" were half pieces of baulks, called "sills," which were tightly keyed all around the bottom of the building; whilst half way up the building were similar pieces, resting on supports on the baulks, called "walings," with bars of iron running through the building, bolted all firmly together. Similar bars ran lengthways of the building. Having thus firmly braced the building together, the lifting commenced. A trench for the men to work in having first been dug, a powerful lifting jack was placed under the end of each "needle," at which a man was stationed, and there were two others under the centre part of the end "needles," and others inside the building, making 31 jacks in all. At a given signal from Mr. Whalley, each man gave a turn to his jack, and as turn after turn was made the building slowly but surely rose, without a crack or flaw, or even a pane of glass breaking; and when the men left work on Monday night they had lifted the whole building 3½ inches (22 inches was the total amount to which the building had to be raised). On Tuesday morning, having secured the building at the point reached, another succession of turns were taken, and 3½ inches more were accomplished by 8.30. The same process was repeated, and by 1 o'clock the amount reached was 13 inches. The afternoon work proceeded without the least hitch, and on leaving off on Tuesday evening, 19½ inches had been reached, and the remaining 2½ inches were subsequently accomplished. The walling was filled in, and the platform raised in the usual way.—*Building News.*

LEYDEN JAR DISCHARGE.

Says a correspondent of the *English Mechanic:* I beg to submit a method by which I succeeded in producing a vivid steel-blue spark, or flash, 10 in. or more in length, and of the apparent thickness of an ordinary slate pencil. The discharge is attended with a sharp explosion very different from, and much louder than, that obtained ordinarily from a Winter's machine, and is as much like a flash of lightning as can well be imagined. Ordinary electrical sparks of very great length (20 in.) have been obtained from frictional machines before; but, as far as I can ascertain, no condensed discharge of the length of 10 in. has been before noted. I believe that by taking some precautions, which have since occurred to me, and by a slight alteration in the arrangement of the apparatus, the usually considered limit (the distance between the rubber and the collecting points) will not prevent me from getting sparks from a Leyden jar 20 to 30 in. in length. My experiments have, however, been stopped rather abruptly for the present by the fog and rainy weather; but as soon as the dry frosty weather makes its appearance, I shall immediately resume them, and, if successful, will most likely communicate the results to our readers—with the editor's permission. I will now describe the apparatus employed, which, as will be seen by the diagram, is nothing more than a long, narrow Leyden jar, slightly modified to suit this particular purpose. The ordinary prime conductor is altogether removed, and in its place I put a glass tube, B, 33 in. long, ¼ in. thick, and 1¼ internal diameter, hermetically sealed at one end. This is silvered throughout its whole length internally by the patent silvering process, and the film of silver forms its internal coating. It is supported in the upright position by the wooden stand, C, which is ¾ in. thick, and into which it slides easily to the distance of a foot, and on the outside of the upright part of this wooden stand, between the line N′ N″, is slipped a piece of brass tubing, D. This forms the outer coating, and is in metallic communication with the rod of the spark-drawer, P, by means of the wire, *x*.



E is a hollow ball of alder wood, 3 in. diameter, saturated with paraffin wax, and made to fit tightly on the glass tube, at its upper and open end. F is a thick brass wire passing through the ball, as shown, and terminating at one end in the 2 in. brass ball, G, and at the other end in the usual collecting comb, which is protected by a wooden shield, H, saturated with paraffin, and which terminates at each end in a 3 in. wooden ball, also paraffined and set back, as shown by the dotted line, K. The wire, F, is placed in metallic connection with the internal coating by pushing into the tube a tuft of very fine hard-drawn brass wire, M, and allowing the upper end to press against F, as shewn at L. The brass-spark drawer, P, is 8 in. diameter, and highly polished, and slides easily into the wooden stand, Q; while its distance is regulated by the screw, *s*. I may mention that to prevent, as far as possible, any loss of electricity, the wire is covered throughout its length with caoutchouc tubing, and the external surface of glass tube is varnished with solution of shellac.

A is the cylinder of machine, and T the silk flap. It will be seen by the above description that it is almost impossible for the electricity to be drawn off by the surrounding bodies, as happens in all cases where the ordinary form of prime conductor is used, and the tendency to burst through the glass tube is overcome by the wooden coating, C, which, being an imperfect conductor, acts, as it were, like a spring or buffer. This apparatus can be employed in all cases in which the usual form of P. C. is used, and by its means vacuum tubes can be as brilliantly illuminated as with a 14 or 15 in. spark induction coil, as I have proved by trial. The cylinder of my machine is 15 in. long, and 12 in. diameter. For smaller cylinders, I should recommend a glass tube of same length as above, but ½ in. diameter.—J. Reynolds.

EXPERIMENTS WITH ATMOSPHERIC ELECTRICITY.

By A. B. Harding.

Having noticed in the *English Mechanic*, a query seeking information as to an exhibit of "flashed metals," shown in the Loan Exhibition at South Kensington, and more recently at the Royal Institution, I take the opportunity of giving a few particulars which may prove interesting to your numerous readers.

First of all, the effects shown were actually produced by atmospheric electricity, and not that of the electrical machine. The experiment (a very daring one), was performed by the late Mr. Andrew Crosse, of Bloomfield, near Taunton, who erected insulating supports throughout his grounds, and on these stretched 3,000 ft. of "exploring wire," by means of which the electricity of the air could be conveyed into the house, and there examined. The wire terminated in a brass conductor, so placed that it could either communicate with the earth by means of a second conductor, or be insulated for experimental purposes.

When connection was made with the inner coating of his great Leyden battery of 50 jars, exposing 146 square feet of coated surface, the effects obtained during a time of aërial electric disturbance were very grand, far surpassing those from the largest machine.

With this battery Mr. Crosse fused into red hot balls 30 ft. of iron wire 1-270th inch thick. Strips of metal laid on glass and placed in circuit, were, on discharge of battery, instantly dissipated, leaving only the metallic streaks noticed by your correspondent. The metals so fused are zinc, tin, lead, and united strips of copper and iron and tin, and gold, silver and copper. These specimens, which belong to me, are, I believe, the only ones in existence, and are extremely curious.

Mr. Crosse made many interesting discoveries by means of his "exploring wire," as to the quality and behaviour of atmospheric electricity. For instance, he found that in fine, cloudy weather the air was invariably charged with positive electricity, increasing in intensity at sunrise and sunset, diminishing at midday, and varying with the amount of evaporation. Thunderclouds he found to contain zones of alternately positive and negative charge, the effects of which upon his electroscopes were manifest. When a thundercloud had passed away from over his collecting wire, he noticed that the air was always unusually free from electric excitement, a gold-leaf electrometer even being unaffected.

If any fellow-reader is interested in the many curious applications of voltaic electricity, to stimulate vegetation, retard decay, to imitate the production in nature of metallic veins, crystals, etc., I can strongly recommend the "Memorials of Andrew Crosse, the Electrician."

NOTES ON THE BOTANY OF THE ROCKY MOUNTAINS.

Sir Joseph Dalton Hooker, the distinguished English botanist and President of the Royal Society, has lately visited this country, and made an extensive tour, concerning which he gives in *Nature* the following notes:

"In company with Dr. Asa Gray, Professor of Botany of Harvard University, Cambridge, U. S., I availed myself of an oft-repeated invitation to us both from Dr. Hayden, the distinguished chief of the Topographical and Geological Survey of the United States Territories, to join the Survey in Colorado and Utah; this we did with the view of instituting a comparison between the floras of these central and elevated territories and those of other parts of the continent, and thus obtaining some insight into the origin and distribution of the North American flora. In order to comprehend the importance of Colorado and Utah as the basis for such investigations, I should state that they occupy a very central position in the continent, and include a section of the Rocky Mountains about 300 miles long and about as broad, namely, from N. lat. 37° to 41°, and from W. long. 105° to 112°.

The mountain region thus limited consists of extensive and often level floored valleys, sometimes many miles broad, and elevated 4,000 to 5,000 feet above the sea, called "parks" in local topography, which are interposed between innumerable rocky mountain ridges of very various geological age and formation, which often reach 12,000 feet, and sometimes 14,000 feet elevation, the maximum being under 14,500.

Those of the so-called parks which are watered by rivers that flow to the east are continuous with the prairies that lie along the eastern flanks of the Rocky Mountains; those watered by rivers that flow to the west are continuous with the so-called desert or salt regions that lie along the western flanks of the range; but the divides between the head waters of the streams that flow either way are often low, and the botanical features of the east and west may hence meet and mix in one park.

Such a section of the Rocky Mountains must hence contain representatives of three very distinct American floras, each characteristic of immense areas of the continent. There are two temperate and two cold or mountain floras, viz.: (1) a prairie flora derived from the eastward; (2) a so-called desert and saline flora derived from the west; (3) a sub-alpine; and (4) an alpine flora; the two latter of widely different origin, and in one sense proper to the Rocky Mountain ranges.

The principal American regions with which the comparison will have first to be instituted are four. Two of these are in a broad sense humid; one, that of the Atlantic coast, and which extends thence west to the Mississippi river, including the forested shores of that river's western affluents; the other that of the Pacific side, from the Sierra Nevada to the western ocean: and two inland that of the northern part of the continent extending to the Polar regions, and that of the southern part extending through New Mexico to the Cordillera of Mexico proper.

The first and second (Atlantic plus Mississippi and the Pacific) regions are traversed by meridional chains of mountains approximately parallel to the Rocky Mountains; namely, on the Atlantic side by the various systems often included under the general term Appalachian, which extended from Maine to Georgia, and on the Pacific side by the Sierra Nevada, which bounds California on the east. The third and fourth of the regions present a continuation of the Rocky Mountains of Colorado and Utah, flanked for a certain distance by an eastern prairie flora extending from the British possessions to Texas, and a western desert or saline flora, extending from the Snake River to Arizona and Mexico. Thus the Colorado and Utah floras might be expected to contain representatives of all the various vegetations of North America except the small tropical region of Florida, which is confined to the extreme south-east of the Continent.

The most singular botanical feature of North America is unquestionably the marked contrast between its two humid floras, namely, those of the Atlantic plus Mississippi, and the Pacific one; this have been ably illustrated and discussed by Dr. Gray in various communications to the American Academy of Sciences, and elsewhere, and he has further largely traced the peculiarities of each to their source, thus laying the foundations for all future researches into the botanical geography of North America; but the relations of the dry intermediate region either to these or to the floras of other countries had not been similarly treated, and this we hope that we have now materials for discussing.

Our course and direction in America was directly westward to Colorado, where we followed the eastern flanks of the Rocky Mountains for about 300 miles, that is from Denver in the north, to near the borders of New Mexico, ascending the highest northern and southern peaks, and visiting several intermediate parks and valleys, watered by tributaries of the Arkansas, Platte, Colorado, and Rio Grande. From Denver we proceeded north to Cheyenne in Wyoming, and thence westward by the Central Pacific Railway, across the range to Ogden, and the Great Salt Lake in Utah, which lies on the base of the Wahsatch Mountains, themselves the western escarpment of the Rocky Mountains proper in that latitude. After ascending these we proceeded westward by rail through Utah, to Nevada, thus crossing the great dry region that intervenes between the Rocky Mountains and the Sierra Nevada, which is variously known as the Desert, Salt, or Sink region of North America, in accordance with the prevailing features of its several parts. It is elevated 3,000 to 4,000 feet, and traversed by numerous short meridional mountain-ridges, often reaching 8,000 feet, and rarely 10,000 feet elevation; unlike the Rocky Mountains or over the Sierra Nevada, these present no forest-clad slopes, or even a sub-Alpine flora.

From Reno, at the western base of the Sierra Nevada, we proceeded south by Carson City, flanking the Sierra for some sixty miles to Silver Mountain, when we struck westwards, ascending the Sierra, which was crossed obliquely into the Pacific slope. There we visited three groves of the 'Big Trees' (*Sequoia gigantea*) at the headwaters of Stanislaus and Tuolumne Rivers, and the singular Yosemite Valley, whence we descended into the great valley of California, and made for San Francisco.

From the latter place we made excursions first to the old Spanish settlement of Monterey, which is classical ground for the botanist, as being the scene of Menzies' labours during the voyage of our countryman, Capt. Vancouver, in 1798 (whose surveys are held in the highest estimation by Prof. Davidson and the officers of the Coast Survey of the United States), whom he accompanied as botanist. Then we went northwards along the coast range to Russian River to visit the forests of Red-wood (*Sequoia sempervirens*), the only living congener of the Big Trees, and almost their rival in bulk and stature. Then to Sacramento, and up the valley of that name for 150 miles to Mount Shasta, a noble forest-clad volcanic cone about 14,400 feet in elevation. Returning thence to Sacramento we took the Union Pacific Railway eastwards, and from the highest station visited Mount Stanford, on the crest of the Sierra Nevada, and Lake Tahoe, which occupies a basin in the mountains at about 7,000 feet elevation, and with which we finished our western journeyings.

In California the Coniferæ were a principal study, with a view of unravelling their tangled synonymy and tracing the variations and distribution of these ill-understood trees, which attain their maximum development in number of species and in stature on the Pacific slope of the American continent.

The net result of our joint investigation and of Dr. Gray's previous intimate knowledge of the elements of the American flora is, that the vegetation of the middle latitudes of the continent resolves itself into three principal meridional floras, incomparably more diverse than those presented by any similar meridians in the old world, being, in fact, as far as the trees, shrubs, and many genera of herbaceous plants are concerned, absolutely distinct. These are the two humid and the dry intermediate regions above indicated.

Each of these, again, is subdivisible into three as follows:—

1. The Atlantic slope plus Mississippi region, subdivisible into (*a*) an Atlantic, (*β*) a Mississippi valley, and (*γ*) an interposed mountain region with a temperate and sub-alpine flora.

2. The Pacific slope, subdivisible into (*a*) a very humid cool forest-clad coast range, (*β*) the great hot, drier Californian valley formed by the San Juan river flowing to the north, and the Sacramento river flowing to the south, both into the Bay of San Francisco; and (*γ*) the Sierra Nevada flora, temperate, sub-alpine, and alpine.

3. The Rocky Mountain region (in its widest sense extending from the Mississippi beyond its forest region to the Sierra Nevada), subdivisible into (*a*) a prairie flora; (*β*) a desert or saline flora; (*γ*) a Rocky Mountain proper flora, temperate, sub-alpine, and alpine.

As above stated, the difference between the floras of the first and second of these regions, is specifically, and to a great extent generically absolute; not a pine or oak, maple, elm, plane, or birch of Eastern America extends to Western, and genera of thirty to fifty species are confined to each. The Rocky Mountain region again, though abundantly distinct from both, has a few elements of the eastern region and still more of the western.

Many interesting facts connected with the origin and distribution of American plants and the introduction of various types into the three regions, presented themselves to our observation or our minds during our wanderings; many of these are suggestive of comparative study with the admirable results of Heer's and Lesquereux's investigations into the pliocene and miocene plants of the north temperate and frigid zones, and which had already engaged Dr. Gray's attention, as may be found in his various publications. No less interesting are the traces of the influence of a glacial and a warmer period in directing the course of migration of Arctic forms southward, and Mexican forms northward in the continent, and of the effects of the great body of water that occupied the whole saline region during (as it would appear) a glacial period.

Lastly, curious information was obtained respecting the ages of not only the big trees of California, but of equally aged pines and junipers, which are proofs of that duration of existing conditions of climate for which evidence has hitherto been sought rather amongst fossil than amongst living organisms.

I need hardly add that the part I played in the above sketched journey was wholly subordinate to Dr. Gray's, who had previously visited both the Rocky Mountains and California, though not with the same object. But for his unflinching determination that nothing should escape my notice which his knowledge and observant powers could supply, and Dr. Hayden's active co-operation, my own labours would have been of little avail.

Moreover, throughout the expedition we experienced great hospitality, and enjoyed unusual facilities, not only from the staff of the Geological Survey, but from the railway authorities, who franked us across the continent, and on all the branch lines which we traversed.

J D Hooker.

HUMAN STATURE.

Which are the tallest men, and which are the shortest? According to Villermé the human stature varies from 1·462m. to 1·787m., and presents an average of 1·625m. If we are guided by the list published by M. Weisbach, in the volume of the *Novara*, the exact average is about 1·610m. If we took the extreme individuals known, who are about 43ctm. (a dwarf cited by Burch and Buffon), and about 2·83m. (a Finlander spoken of by M. Sappey), it would be about 1·630m. Lastly, taking a million and a quarter of soldiers of North America, examined by M. Gould—soldiers whose minimum and maximum are respectively 1·016m. and 2·005m. this average will be about 1.555m., which is smaller than the preceding; but the extreme cases may be regarded as abnormal, if not pathological, and they need not enter into any calculation of the average.

Let us commence with the smallest men. The Esquimaux have long passed for the smallest citizens of the universe, on the assertion of Herr De Paw that their men are 1·299m., and their women 1·271m. Drs. Bellebon and Guerault affirm that it is universally known that they are very small, and rarely exceed 1·50m. Still, when we seek the proof in precise measurements, these are entirely wanting.

From figures cited hitherto, it results that among them the smallest averages f ᵣ the masculine sex are about 1·585, and that there are tribes having a really high stature of 1·708m. The stature increases as we go from east to west—from the eastern bank of Baffin's Straits to the island of St. Laurent, in Behring's Straits, which is probably due to crossing with the Indians of North America.

The Esquimaux are thus not favorable to the doctrine which regards cold climates as producing only small men. It is the thick and large costume of those inhabitants of the high north which makes them pass for people of small stature.

The same doctrine of climates is applied to the Laplanders; but the measurements hitherto taken give for the men an average of 1·535m., and for the women an average of 1·421m. Thus they enter into the group of people of small stature. As to the Pescherais, or Fuegians (inhabitants of Terra del Fuego), which this same theory supposes should be very small, they are, on the contrary, above the average.

With regard to smallness, the place of honor must be given to the Boschimans of South Africa. With them the general average of both sexes is below 1·400m. Other negroes of Africa rival them. There are the Akkas, whose average is also about 1·400m. according to M. Schweinfurth, and the Obongos, of whom Du Chaillu measured six females, who were 1·428m., and a young man 1·371m.

In Oceania, finally, a negro race of small stature has some time ago entered the lists—viz., the Negritos, whose most authentic representatives are to be seen in the Philippines, in the Andamans, and in the peninsula of Malacca. But, however small they may be, they cannot compete for smallness with the Boschimans, who are decidedly the smallest inhabitants of the globe.

On the other hand, which is the race of greatest stature? The Norwegians in Europe, the Kaffirs in South Africa, certain of the Indians of North America, the Polynesians, and the Patagonians, are among the number. But the rivalry is rather confined to these two latter. The races which inhabit Patagonia are of varied character. In the north are the Tehuelchans, who seem to belong to the Araucanian race—the Puelchans, who are related to that of the Patagonians of the south, and the Huillichans, taller than the Araucanians, to which, however, they are referred. In the south we again find the Tehuelchans, principally between the Straits of Magellan and the river Santa-Conz. Lastly, in Terra del Fuego are the Pescherais, who are also of the Araucanian race.

All are nomads; their hordes make numerous incursions on each other, so that one may accidently find in a region tribes which do not belong to it. Most information refers to the Tehuelchans, or at least the natives of the south. We will not repeat the fabulous stories of the first navigators about their colossal stature, though M. Martin de Moussy has met with veritable giants, not among the Tehuelchans, but among the Huillichans, who spread sometimes to the Straits.

D'Orbigny has spoken very strongly against the exaggeration of the early navigators. M. de Rochas asserts that D'Orbigny saw only the Patagonians of the north-east. From all the measurements hitherto obtained we do not think we have a right to conclude that the Tehuelchanns, already mixed at the epoch of the pre-historic "paraderos" dug up by M. Morens, count among their ancestors a race of prodigious stature. The average of statures of the Patagonians, given by travelers worthy of credit, is about 1·781m

Calculating the average of measurements made by navigators on the inhabitants of the different Polynesian archipelagos, we get 1·762m., which is slightly less than for the Patagonians. The Polynesians are reported to have come from the east, and the Patagonians from the west.

To sum up, the highest statures recorded amongst these peoples are 2·057m. among the Patagonians, and the smallest about 1·219m. among the Boschimans of the male sex; giving for intermediate point 1·638m. But chance has too great play in the meeting with a tall or a small individual; it is better to compare general averages.

From 1·78m. with the Patagonians or 1·853m. with the Samoans (according to Lapeyrouse), this average descends to 1·351m. with the Boschimans; whence, for intermediate point, we have 1·566m., taking the Patagonians, and 1·602m. with the Samoans. Thus it is in the neighborhood of, and a little over 1·600m., that we find the average stature of humanity.

Nevertheless, in our opinion, this average should be placed a little higher—for this reason, that in the 130 series we have collected as they presented themselves, all of the male sex, more than a half (76) have been found over 1·650m.

While recognising that the average stature between these two extremes, presented both by individuals and by the average of race, is about 1·600m., if not a little under it, we propose to adopt the term of 1·650m., as the central point whence diverge the divisions with regard to stature.—*Revue d'Anthropologie.*

SILVERING GLASS.

By D. C. Chapman, New York.

Having had occasion to silver some small plates of glass, I tried several formulas. In some I found the silver solution so weak that it required repeated applications to give an opaque deposit. In others the silver was so strong that there appeared to be a waste. After trying several modifications I found that the following works very finely, giving a heavy deposit by a single application:

No. 1.—*Reducing Solution:* In 12 ozs. of water dissolve 12 grains Rochelle salts, and boil. Add, while boiling, 16 grains nitrate of silver, dissolved in 1 oz. of water, and continue the boiling for 10 minutes more; then add water to make 12 ozs.

No. 2.—*Silvering Solution:* Dissolve 1 oz. nitrate of silver in 10 ozs. water; then add liquid ammonia until the brown precipitate is nearly, but not quite, all dissolved; then add 1 oz. alcohol and sufficient water to make 12 ozs.

TO SILVER.

Take equal parts of Nos. 1 and 2, mix thoroughly, and lay the glass, face down, on the top of the mixture while wet, after it has been carefully cleaned with soda and well rinsed with clean water.

Distilled water should be used for making the solutions.

About 2 drachms of each will silver a plate 2 inches square. The dish in which the silvering is done should be only a little larger than the plate. The solution should stand and settle for two or three days before being used, and will keep good a long time.

SILVERING GLASS—DRAPER'S METHOD.

W. P. H. asks: How is the concave surface of a glass reflector for a reflecting telescope silvered on the inside? Answer: Draper's method of silvering glass: Dissolve 560 grains Rochelle salts in 3 ozs. of water. Dissolve 800 grains nitrate of silver in 4 ozs. of water. Add silver solution to an ounce of strong ammonia until brown oxide of silver remains undissolved. Then add, alternately, ammonia and silver solution carefully until the nitrate of silver is exhausted, when a little of the brown precipitate should remain; filter. Just before using mix with the Rochelle salt solution, and dilute to 22 ozs. Clean the mirror with nitric acid or plain collodion and tissue paper. Coat a tin pan with beeswax and rosin, equal parts. Fasten a stick ½ inch thick across the bottom. Pour in the silvering solution. Put in quickly the glass mirror, face downward, one edge first. Carry the pan to the window and rock the glass slowly for half an hour. Bright objects should now be scarcely visible through the film. Take out the mirror; set it on edge on blotting-paper to dry. When thoroughly dry, lay it, face up, on a dusted table. Stuff a piece of softest thin buckskin loosely with cotton. Go gently over the whole silver surface with this rubber in circular strokes. Put some very fine rouge on a piece of buckskin, laid flat, on the table, and impregnate the rubber with it. The best stroke for polishing is a motion in small circles, at times going gradually round on the mirror, at times across, on the various chords. At the end of an hour of continuous gentle rubbing, with occasional touches on the flat, rouged skin, the surface will be polished so as to be perfectly black in opaque positions, and, with moderate care, scratchless. It is best, before silvering, to warm the bottle of silver solution and the mirror in water heated to 100° Fah.

SILVERING GLASS—SIEMENS' METHOD.

For a long time aldehyde has been employed in the glass silvering process suggested by Liebig, but some difficulties of manipulation have led practical men to prefer other reducing agents. R. Siemens has modified the operation and greatly simplified the reducing of the silver. Dry ammonia gas is passed through aldehyde to produce aldehyde ammonia; 2·5 grammes of aldehyde ammonia and 4 grammes nitrate of silver to 1 liter of water is the proper proportion to take. The nitrate of silver and aldehyde ammonia are separately dissolved in distilled water, mixed and filtered. The object to be silvered must be thoroughly worked to free it from fat, and, if it be a globe or bottle, the liquid is poured in as high as it is desired to form the deposit. As soon as the heat which must be applied shows 50° C., the separation of the silver begins and soon spreads itself all over the whole surface. At first, when the coating is very thin, it looks dark, but soon assumes a metallic luster; when it is a brilliant white it is time to remove the fluid contents, as the mirror is apt to be injured by too long contact with the aldehyde. Flat objects are laid upon the mixture in the usual manner. In Germany, where aldehyde ammonia can be purchased at a reasonable cost, this process is highly prized. By making his own salt in the manner described above, the chemist in this country can also avail himself of the method. The simplicity of Siemens' process commends it to favor.

SILVERING GLASS—PETITJEAN'S METHOD.

Up to 1840 mirrors were silvered exclusively by means of an amalgam, a process most destructive to the workmen employed. An important step was effected by an English chemist, Drayton, who conceived the idea of coating mirrors with a thin layer of silver, obtained by reducing an ammoniacal solution of nitrate of silver, by means of highly oxidizable essential oils. This process was subsequently modified by several chemists, but only became really practical when M. Petitjean substituted tartaricacid for the reducing agents formerly employed. The glass to be silvered is laid upon a horizontal cast-iron table heated to 104° Fah. The surface is well cleaned, and solutions of silver and tartaric acid, suitably diluted, are poured upon it. The liquid, in consequence of a well-known effect of capillarity, does not flow over the edges, forming a layer a fraction of an inch in thickness. In twenty minutes the silver begins to be deposited on the glass, and in an hour and a quarter the process is complete. The liquid is poured off the glass, washed with distilled water, dried, and covered with a varnish to preserve the silver from friction.

The advantages are evident. Mercury, with its sanitary evils, is suppressed; there is a gain in point of cost, as 60 to 75 grains of silver, costing about 20 cents, suffice for 10·75 square feet, which, under the old system, would require 1¼ lbs. of tin and the same weight of mercury. A few hours suffice to finish a glass on the new system, while the old process required 12 days as the minimum. On the other hand, the glasses thus silvered have a more yellowish tint; portions of the pellicle of silver sometimes become detached, especially if exposed to the direct action of the sun, and, despite the protecting varnish, the silver is sometimes blackened by sulphuretted hydrogen. M. Lenoir has happily succeeded in overcoming these defects by a process alike simple and free from objections on sanitary grounds. The glass, silvered as above, is washed, and then sprinkled with a dilute solution of the double cyanide of mercury and potassium. The silver displaces a part of the mercury and enters into solution, while the rest of the silver forms an amalgam whiter and much more adhesive to glass than pure silver. The transformation is instantaneous. The amount of mercury fixed does not exceed 5 to 6 per cent. The glass thus prepared is free from the yellowish tint of pure silver. It is also less attacked by sulphur vapors and the rays of the sun, in which last request it is superior to mirrors silvered by the old process.—*Bulletin de la Société d'Encouragement pour l'Industrie Nationale.*

SILVERING GLASS.—BY A. LAVAL, ST. LOUIS, MO.

In carrying out my invention I prepare the ingredients: I first take eighty grams of nitrate of silver (either lunar caustic or the crystallized salt), and dissolve it in ten ounces of water, preferably distilled or rain water. To this I add two ounces of alcohol and two ounces of aqua-ammonia. The ammonia is added to the solution drop by drop, until the precipitate at first formed is dissolved. The solution is then allowed to settle for three or four hours, when it is ready for use, and forms solution No. 1. I then take six ounces of water and dissolve it in twenty-four grams of nitrate of silver, and add to the same thirty grams of arsenite or tartrate of copper, and then add, drop by drop, sufficient aqua-ammonia to dissolve the precipitate of oxide of silver at first formed, and the arsenite or tartrate of copper, after which add two ounces of alcohol. I then make a separate solution of forty-eight grams of potassa in sixteen ounces of water. This last-mentioned solution is brought to a boiling temperature in an evaporating-dish, after which the solution of nitrate of silver and arsenite or tartrate of copper is added, drop by drop, to the boiling solution of potassa, and the boiling is continued for about an hour, or until a white film collects on the surface, after which it is allowed to cool and filter, when it is ready for use, and forms solution No. 2.

In depositing the alloy upon the glass, I take a suitable quantity of filtered water, preferably rain or distilled water, and add to it equal parts of solutions Nos. 1 and 2, and mix the whole thoroughly, and apply this solution in any convenient manner to the glass to be coated, and the deposition immediately commences, and is allowed to continue, say for about ten minutes, until the metal in solution is entirely exhausted, when the glass will be covered with a coating of the alloy, having a brilliant reflecting surface adjoining the glass.

In order to increase the durability of the coating, I prefer to deposit a second coating upon the first, which is done by repeating the operation before the first coating is dry, and after the coating is completed I generally cover the whole with a heavy coat of asphaltum varnish, although this is not absolutely necessary, as the metallic alloy is sufficiently hard to stand ordinary wear without it.

By the above-described process an alloy having all the qualities of hardness and durability of the ordinary alloys of copper and silver is deposited upon the glass, and the degree of hardness may be varied or modified by varying the proportions of the different ingredients employed. Other salts of copper besides the arsenite or tartrate may be employed in conjunction with the nitrate of silver.

WATCH OILS.

An oil fit to be used as a lubricator for fine mechanism should possess the following essential qualities: It should neither thicken nor dry up, nor get hard at a low temperature, nor should it be subject to oxidation. In spite of the vast progress natural science has made of late years, it has not succeeded in discovering an animal or vegetable oil possessing these combined properties without previous artificial manipulation. Let us mention a few instances:

Almond oil has the valuable property not to become firm till below 17 deg. R, but it oxidates sooner than any other oil. Poppy-seed oil will withstand cold to 15 deg. R., and preserves itself well from oxidation: but it is one of the "drying oils," and therefore useless as a watch oil. Olive oil, up to the present the most useful among watch oils, does not dry or thicken, nor does it oxidate for a comparatively long time, but it hardens already at 2 deg. R. The properties of neat's foot oil are similar to those of olive oil, but it exceeds the latter in resistance against oxidation. These few observations will sufficiently show why technical chemistry always considered the production of an oil, fulfilling in every respect the requirements of fine mechanics, as one of the most difficult tasks. Most of the oils supplied to the trade answer this purpose but imperfectly. It is, therefore, not to be wondered at when conscientious men act with caution in introducing any novelty in that department; the more so, because the hitherto employed methods for testing oils required considerable time, and were often attended with loss. We think it will be useful to our readers if we point out the means by which such tests can be made with the least trouble and cost, and in the shortest time. We will first divide the oils into two classes:

Drying Oils.—The best known among which are: Linseed, hemp-seed, poppy-seed and castor oil.

Non-drying Oils.—To which belong olive and colza oils, and those from the larger kernels, as almonds, hazel and beech n 's, etc.

That drying oils are useless and objectionable for fine mechanism is evident, because they dry on exposure to the air by absorbing oxygen and generate carbonic acid. The quicker or slower drying depends simply upon the thickness with which the oil has been applied. A higher temperature will considerably accelerate the effects of oxygen, an advantage of which painters and cabinet makers—the principal consumers of this kind of oils—avail themselves when despatch in their work is required. Oils, as regards this point, are, therefore, very easily proved. The article to be examined is laid as thin as possible on a piece of glass or china, and the latter is then put on a stove, care being taken not to expose it to too high a temperature, to prevent the oil from boiling, which would take place at 240 deg. R.—is quite sufficient to dry a thin layer of such an oil into a glassy substance in a few days. This simple process supersedes all others. There are oils which do not belong to this class, but gradually thicken because they contain considerable quantities of mucilage, pectic acid, etc. Such is the case with oils from the larger kernels, as almonds, beech and hazel nuts. An exposure of these oils to a higher temperature will, in a few hours, manifest this defect also. The next evil lies in the little resistance which oils offer to lower degrees of temperature. Every fat is, again, a conglomeration of other solid and liquid substances. The former are called stearine, margarin, palmitin; and the latter, olein, elain. According to the proportions of solid and liquid substances, the fat requires a higher or lower temperature to become liquid or solid. Tallow, for instance, melts only at 32 deg. R., while linseed oil remains still liquid at 22 deg. R. An oil which can resist 10 deg. R. will do very well for general purposes. The temperature in a room, even without a fire, will, at 25 deg. R. in the open air, not sink below 8 deg. to 10 deg. R., and besides, in the watch pocket, next to the body, the watch is safely guarded from extreme cold. The watch manufacturer has not to consider extraordinary cases, and if inhabitants of the frigid zone and Arctic navigators expose their chronometers to extreme degrees of cold in the open air, he is not answerable for the rash treatment of his work. If oils have to be tried as to their capability of withstanding a low temperature in summer time, the necessary degrees of cold may be produced as follows: 15 parts of Glauber's salt (the small crystallized sort) are put in a vessel of glass or china, and the flask of oil to be tested is immersed in it. This done, a mixture of 5 parts of muriatic acid and 5 parts of cold water is poured over the salt. By means of a thermometer, such as is used for liquids, the temperature can be controlled, and when it shows 8 deg. to 10 deg. R., the flask may be taken out and the oil examined. If it has remained perfectly liquid, it has satisfactorily undergone the required test. Chemists can without difficulty separate the firm ingredients from oil, and produce an article which will stand 25 deg. R., but this cannot be done without injuring it in other respects.

We come now to the most serious of all defects in watch oils, viz., oxidation, and therefore give our special attention thereto. Fats in general (liquid as well as solid) belong to the saline bodies, although they have in appearance nothing

in common with salt. Salt is the name chemists give to a combination of an acid with a base, and under these bases they understand the oxides of iron, copper, etc., the alkalies, the alkaline earths, as lime, baryta, etc. The well-known Glauber's salt is also a combination of sulphuric acid with sodium for its base. The same base with carbonic makes our soda; and kitchen salt consists of chlorine with sodium for its base; or, more exactly, with the elementary substance of sodium, the natrium. If in this combination the acid is predominant, it is called acetic salt; if the base, basic salt; and if they are both alike, neutral salt. Such neutral salts are all our natural healthy fats. The acids they contain are called pyroleic acids (stearic acid, elaic acid, etc.), and the base, not yet known in its elementary state, is termed lipyloxyd, which, by further development, produces the better-known glycerine. Although these pyroleic acids are naturally neutral, and when bound to their bases cannot act as acids, yet they have an inclination to absorb oxygen from the surrounding atmosphere, especially at higher degrees of heat. This is what, in chemistry, is called oxidation. If this process continues, the acid in the oil becomes predominant, and then acts on metals precisely in the same way as any other acid, only its damage is slower and less apparent to the eye. The result is evident. Fine works, lubricated with such an oil, lose in volume, and the injury, which is often attributed to friction, is in reality the effects of this change in the oil. But this condition of the oil does not manifest itself till it has attained a highly injurious degree, and the work of destruction has already begun. The organs of taste and smell are therefore insufficient to ascertain what degree of inclination an oil has to become rancid, or even to indicate at once when it has actually become so. The following method will answer this purpose: Pour the oil in a bottle, together with an equal quantity of water, in which soda (carbonic natrium) has been dissolved; then shake it violently and let the mixture stand for some hours. If the two liquids separate perfectly, particularly under a higher temperature, it is a proof that the oil is free from acid. On the contrary, if a whitey substance shows itself between the two, it is certain that acid is present. Another method is based on the great sensibility of litmus paper in regard to acids. Litmus paper can be bought at the chemist's, but may be easily prepared as follows: Bring powdered litmus in contact with pure water (distilled is best) until the latter has absorbed enough coloring matter to dye dark blue immersed slips of paper. These slips are then thoroughly dried, and any acid applied to them will change their color to a violet, or even red, according to the strength of it. Acids which have become free in an oil will have the same effect. It must be remarked that litmus blue, held to the light, is of a reddish tint in itself; and that litmus tincture, well shaken, will present rays of glaring red in the sunlight, and, as the papers immersed in the oil become transparent, they will show a light reddish hue even in the purest oil. But a little practice and comparison will soon enable one to distinguish the effects of an acid on litmus blue.

In conclusion, we may correct a few traditional errors. Many think that the clearer an oil the better it is. A bad color certainly indicates impurities, but if colorless or yellow it is in this respect immaterial. In fact, those very clear oils are generally most apt to become rancid, because the methods employed for the clearing process tend mostly to forward oxidation. To test the fluidity of oils by letting different sorts run off an inclined plane is also a doubtful experiment. Not only are there oils so poor in body that they flow too freely, and do not give the required protection against friction, like the sesame oil, but many other obstacles—scarcely observable with the naked eye—such as a slight unevenness in the surface of the plane, may influence the trial. A far more reliable way of ascertaining the desired degree of fluidity is to saturate a strip of blotting-paper with the oil, and watch whether the drops will fall off in pearls, or show an inclination to spread out. The latter is a certain sign of a viscid oil.—*German Watchmakers' Journal.*

OIL OF TURPENTINE, ROSIN AND TURPENTINE.

By ISIDORE ZACHARIAS, PH. G.

TURPENTINE is the oleoresin of Pinus palustris and other species of Pinus. This is a large indigenous tree, growing in dry, sandy soil, from the southern part of Virginia to the Gulf of Mexico; it is 60 to 70 feet high, and the diameter of its trunk about 15 or 18 inches for two-third of its height; the leaves are about a foot in length, of a brilliant green color, and united in bunches at the ends of the branches. The manufacture of turpentine was for a long time only carried on in North and South Carolina, but, since the last few years, Messrs. Lippman Brothers, of Savannah, Ga., had their attention attracted by the vast forests of pine trees in Georgia and Florida, and to them is due the credit of having opened a branch of business which is increasing yearly. The number of barrels received the first year were in the neighborhood of 3,850; the receipts for last year amounted to about 28,000 barrels rosin and turpentine.

The mode of extracting the crude turpentine from the trees is as follows: During the fall and winter of the year the trees are, what is termed by manufacturers of turpentine, "boxed;" excavations are made into the trunk of the trees about 6 to 8 inches above the roots; the shape of these so called "boxes" is somewhat peculiar, the lower lip is horizontal, the upper arched, the bottom of the "box" is about 5 inches below the lower lip and 8 to 10 below the upper; the capacity of these "boxes" varies between ½ to 1 gallon. In a day or two after the "boxes" are made, the trees are deprived of the bark to the height of about 3 feet above the "box and also some of the wood is scraped off, in order to allow the so-called *crude* to exude; this is termed "hacking," the hacks being made in the shape of a letter L, and either closed or open; from this the *crude* begins to flow about the middle of March, runs best during July and August and begins to slacken again in September and October. After the "boxes" are filled the *crude* is dipped out by what they call "turpentine dippers," a peculiarly constructed spoon or ladle, into barrels which are generally made of pine and of a rude construction, or sometimes old lard and other barrels are used. These are then removed to the still, where it is allowed to thicken sufficiently to distil off the oil, or *spirits*, as it is usually called.

The trees require scraping every 8 or 10 days so as to expose a new surface, the flow of the former hacking being clogged by the congelation of resin; a very slight scrape is all that is necessary to set the *crude* flowing again. The number of "boxes" in a tree depends upon its size. The trees are good for a number of years, though they are hardly fit for use after four or five years, the rosin not being worth much, and its yield of oil of turpentine is very slight. The trees are scraped in some instances for such a number of years that ladders are necessary to hack the tree afresh; therefore, the oleoresin, as it flows downwards into the "boxes," becomes somewhat congealed, and some of the oil evaporates so that it must be scraped off; it is then put into barrels and afterwards distilled; it takes about 10 barrels of *crude* to produce 2 barrels of *spirits* and 6 of *rosin*. The flow of the first year is always the best and is therefore called "virgin dip." The next process is

THE DISTILLATION OF THE OIL.

After sufficient *crude* has been collected the barrels are emptied in the still, which generally holds between 12 and 20 barrels. The still is mostly, or perhaps always, made of copper; its shape that of the common copper still, an illustration of which can be seen in Parrish's "Pharmacy," p. 76). The head of the still is connected with the worm, which is contained in a large tank surrounded by water, by a long, wide piece of copper. The still is set in a brick furnace, and, after it has been filled, the dirt, scraps of wood and other impurities are skimmed off, after which the head is adjusted and luted on, then heat is applied, when the oil runs through the worm and is collected in a barrel placed at the bottom of the tank containing the worm. Water is condensed with the oil, but as it flows into the barrel, the water, being the heaviest, sinks to the bottom, and the oil is dipped out and emptied into regular spirit barrels in which we find it in commerce. Water is added from time to time to keep the *crude* in a soft consistence, for when it becomes too thick it takes longer to boil, thereby injuring the product. The water is added through an opening in the still head. After nearly all the oil has been extracted the head of the still is taken off, and a stop-cock, which is situated near the bottom of the still, is opened, and the residue, which is rosin, flows out and passes through three or four large strainers, the bottom one being covered with cotton batting, into a large trough, from where it is dipped into barrels made for that purpose; said barrels contain between 280 and 400 lbs. As stated before, care must be taken to keep sufficient water in the still, otherwise the rosin becomes charred black. The rosin of the first years' dip is the best, and is consequently worth the most; the opaqueness of rosin is caused by too much water being left in the still. The rosin for the first part of the season of the first year's product is very light-colored and transparent, like "window glass." Each succeeding year the color becomes darker, and finally the rosin is black or nearly so, and there is a very small yield of the oil. We often obtain rosin which is very so t, owing to too much of the oil being left to run out with the rosin.

The method of obtaining tar, as practised by the manufactures, is very simple. A large hole is dug in the ground, in which are placed pieces of pine, one on the other. After a sufficient quantity has been placed therein they are slowly burnt, when the tar exudes and flows through a trench into a trough, where is ladled out into barrels; in this way it is generally contaminated with chips, dirt, etc. This product is capable of being distilled, when some pyroligneous acid and an oil of tar are obtained, and what is left is pitch.

REMOVAL OF STRONG ODORS FROM THE HANDS.

THE *Schweizerische Wochenschrift fur Pharmacie* has a communication from F. Schneider, in which he states that mustard, mixed with a little water, is an excellent agent for cleansing the hands after handling odorous substances, such as cod-liver oil, musk, valerianic acid, and its salts. Scale pans and vessels may also be readily freed from odor by the same method.

A. Huber states that all oily seeds, when powdered, answer this purpose. The explanation of this action is somewhat doubtful, but it is not improbable that the odorous bodies are dissolved by the fatty oil of the seed, and emulsionized by the contact with water. In the case of bitter almonds and mustard the development of ethereal oil, under the influence of water, may perhaps be an additional help to destroy foreign odors. The author mentions that the smell of carbolic acid may be removed by rubbing the hands with damp flax-seed meal, and that cod-liver oil bottles may be cleansed with a little of the same or olive oil.

RAPID FILTERING.

By C. HOLTHOF.

The apparatus consists of a large flask, holding 5 or 6 litres, connected by caoutchouc tubing with another flask through a cork in which passes the funnel containing the filter. The large flask is connected also with a manometer, and also with a short piece of glass tubing, which again passes through a cork into a tube shaped like a calcium chloride tube. To the end of the short glass tube within the calcium chloride tube is fitted a piece of caoutchouc tube, the other extremity of which is closed by a glass rod; a slit is made in this caoutchouc tube which is thus transformed into a Bunsen valve. The narrow end of the calcium chloride tube passes downwards through a cork into the lower part of the cylinder of an air-pump, or into an ordinary large-sized zinc syringe. The syringe or air-pump cylinder communicates with the outer air by means of a short piece of glass tubing passing through a second hole in the cork; this glass tube is also closed by a Bunsen valve. When the piston of the syringe or cylinder is drawn back, the valve in the little piece of tubing closes and shuts off connection with the outer air, while that in the tube within the calcium chloride tube opens by reason of the increased pressure from within, and allows the air in the large flask to rush into the cylinder or syringe.—*Zeitschr. Anal. Chem.*

INGENIOUS METHOD OF WEIGHTING WOOLEN CLOTH.

ACCORDING to the *Deutsche Wollengewerbe* the German manufacturers have hit upon a very ingenious method of weighting the woolen cloth, viz., by felting into it the flocks made in cropping cloth. Our contemporary has a letter which states that there are manufacturers who, into a piece of cloth weighing when coming from the loom 19 lbs. in a length of 38 yards, introduce so much flock that the finished article, measuring 30 yards, weighs no less than 30 lbs. If such a piece of cloth loses about 20 per cent during the process of finishing, it follows that the "doctored" cloth contains no less than 15 lbs., or 50 per cent. of flocks. The writer in question asks whether such a cloth is able to stand the friction produced by wearing, and maintains, not wrongfully, that it will often lose a good deal only while in the hands of the tailor. He does not seem to condemn the practice of thus filling the cloth, but merely the tendency to overdo the thing. He says quite correctly that this flock cannot amalgamate or felt with the yarn, because it has no staple, but thinks that a thin and open cloth is benefited by it, as the fine flock fills the interstices between the threads, and thus prevents the cloth from shrinking. Rather a lame excuse we should think. Our friend, in his modest way of thinking, believes that nobody would think of calling his manipulation cheating, any more than the well-known use of inferior yarns for the back of certain cloths. We do not know whether our Yorkshire manufacturers have already practised this ingenious way of "improving" the cloth, but would recommend them to try it on some of their loose shoddy manufactures; it would be an interesting coat made of shoddy and woolen flocks.

We suspect that the process is not unknown in this country (or America), for the *Moniteur de la Teinture* has an article by Mr. Slater, upon an ingenious way of felting only one side of the cloth, the production of which, Mr. Slater says, has puzzled many manufacturers. The piece to be operated upon is spread out, and one side covered with the necessary amount of flocks; it is then doubled lengthways, and the two selvages sewn together so as to form a sack containing the flocks. The piece of cloth is then passed through the rollers or other fulling apparatus as usual, care being taken that the two ends are also sewn up. In this manner the interior of the tube or sack gets felted while the other side of the cloth remains unchanged. The inventor can thus fix beforehand the exact amount of flock to be introduced upon the cloth, and there is no loss of flock. By a special arrangement invented by Mr. Slater, the flock is evenly distributed and felted upon the cloth; he can also produce the same result by sewing two different pieces of cloth together in the manner mentioned above, or by sewing upon one piece of cloth a piece of calico or any other material which does not felt.

Since writing the foregoing we find that the French technical papers are exceedingly wroth at what they call a new fraud in the manufacture of cloth, and the *Journal des Tailleurs* announces that it will examine all cloth brought to it, and expose the manufacturers by name who resort to this fraud.—*Textile Manufacturer.*

THE SILK INDUSTRY IN EUROPE.

THE *Moniteur des Fils et Tissues* says, that, until 1814, there was scarcely any silk weaving (in Switzerland, which then chiefly occupied itself with muslins; but when Napoleon's decree shut cotton out from the Continent, the Swiss took up silk weaving, a capital instance of the folly of restrictions of that class. In 1828 Zurich had 10,000 looms at work. The number was doubled in 1855, and in 1876 there were more than 26,000 men employed in the trade, and the quantity of silk woven amounted to more than a million pounds in weight, and upwards of 300,000 pieces per annum. Taking into account the production of warp silk and sewing silk, and the working of spun silk, Zurich alone had 39,000 men partly engaged in that trade, and partly in agriculture. Many other places besides Zurich have considerable silk works, and the total export amounts to upwards of four and a half millions sterling per annum. Swiss silks take a good position besides those of France, England, and Germany, and in the United States they are esteemed to rank with the best.

In Austria there are about 150 silk mills, some of which have 6,000 hand, and 200 power-looms; and some narrow weavers have nearly 3,000 looms. The total manufacture is estimated at sixteen millions of florins; labor is cheap, as it is in Switzerland, and Austria possesses a great advantage over Germany and Switzerland, namely, that the Tyrol produces silk of excellent quality, and that Hungary, Dalmatia, and other parts of the empire and kingdom are very favorable to growth of the mulberry tree.

Spain, which had a reputation for her silks before either France or England, had lost all her prestige; all that remains to her of the trade is the breeding of worms, and the export of some raw silk.

Portugal, which once rivalled Spain, is much in the same condition; she now gets most of her silks from France, in exchange for about two million pounds weight of coccons.

Russia, Belgium, Sweden, and Holland possess few silk mills, which supply but a small part of the home demand.

Five countries at present divide the chief silk trade between them; they are France, England, Germany, Switzerland, and Austria, and of these only two produce the raw material. England gets the major part of hers from Bengal, China, and Japan; Germany draws 87 per cent from Italy, which supplies also nearly all Switzerland and a good part of Austria. The silk-producing countries stand in the following order of importance; Italy, France, Austria, Spain, and Portugal.

Whatever may be the efforts of the northern nations, they must naturally stand in an inferior condition, as compared with the silk-producing countries. England it is true, has greatly extended her manufacture through her relation with China, and the disease amongst the silkworms in Europe, which forced Italy and France to transform their manufacture.

The success obtained by the Italians during the last few years in the breeding of worms has established the equilibrium in favor of the people of the south. Austria alone is actively at work in both directions; and it is in that direction that our attention is especially called, for that country is as well placed as France, and, although her production is at present infinitely less, it is growing rapidly. Two or three good crops of silk would be sufficient to give great extension to her foreign trade.

A new epoch of struggles will therefore commence in a few years. This will certainly not be fatal to French industry, but it is necessary to make preparations far ahead, in order not to be taken unawares; a complete reformation is required in the machinery, and appliances in use in the foreign relations of France, and, above all, the resuscitation of the breeding of the worms and winding of the silk.

TESTING WOOL.

IN a letter addressed to the editor of the *Journal d'Agriculture*, M. Viret calls attention to an apparently simple method of detecting the admixture of inferior wool with fleeces purporting to be of superior quality. It appears to be a common practice among a certain class of dealers to mix German wool with Australian wools of only half the value, and Spanish fleeces are similarly deteriorated by the addition of inferior Morocco. These are the most prevalent "tricks of the trade," but there are others in abundance. In certain cases the identification of a wool is easy, Russian and Buenos Ayres wools, for example, being readily distinguished from all others by the presence in the fleece of wi l

oats in the one instance, and a peculiar variety of small thistles in the other. But in German, Spanish, Australian, and Morocco wools no such test is applicable. To distinguish between these, M. Viret recommends us to have recourse to entomology. The fleeces from each of these countries will be found to contain coleopterous insects peculiar to it, and by an examination of these the real source of a wool in fleece may be indisputably determined, by whatever name a dishonest stapler may have placed it on the market. M. Viret adds that the credit for this suggestion is due to M. A. Levoiturier, of Elbeuf, who introduced it to the notice of the Entomological Society of France several years ago.—*The Farmer.*

ON THE PROTECTION FROM ATMOSPHERIC ACTION WHICH IS IMPARTED TO METALS BY A COATING OF CERTAIN OF THEIR OWN OXIDES RESPECTIVELY.*

By JOHN PERCY, M.D., F.R.S.

THERE appeared in the *Times* of March 6th, 1877, an announcement, in glowing language, of an alleged discovery by Professor Barff, by which iron might be effectually prevented from rusting, and "however much exposed to weather, corrosive vapors, or liquids," might be rendered "practically indestructible and everlasting." The process consists in exposing iron to the action of superheated steam, whereby it acquires a tenaciously adherent coating of one of its own oxides, viz., magnetic oxide, which it is asserted protects the underlying metal not only from atmospheric oxidation, but also from that of corrosive re-agents. The fact that magnetic oxide would be formed under these conditions was known to every chemist, notwithstanding the statement of the writer of the article in the *Times* that it was discovered by Professor Barff. That iron upon the surface of which a coating of magnetic oxide has been formed by the joint action of heat and atmospheric air is preserved in a greater or less degree from rusting, is a fact well known, I should suppose to every member of the Institute before the announcement of Professor Barff's discovery; and, perhaps, the most striking example that can be adduced of in proof of such protective action is afforded by a variety of Russian sheet iron. In a pamphlet which I published in 1871, I described the special character of this sheet iron, and communicated such information as I had been able to procure concerning its manufacture. The following is a quotation from that pamphlet:—"A particular kind of sheet iron is manufactured in Russia, which, so far as I know, has not been produced elsewhere. It is remarkable for its smooth, glossy surface, which is a dark metallic grey, and not bluish grey, like that of common sheet iron. On bending it backwards and forwards with the fingers, no scale is separated, as is the case with sheet iron manufactured in the ordinary way by rolling; but on folding it closely, as though it were paper, and unfolding it, small scales are detached along the line of the fold . . . . . .This sheet iron is in considerable demand in Russia for roofing, and in the United States, where it is largely used in the construction of stoves and for encasing locomotive engines. Now, from the circumstance of its being applied to the purposes just mentioned, especially roofing, in such a climate as that of Russia, it may be inferred that it must be much less liable to rust than ordinary sheet iron, and of the correctness of that inference I have had personal experience. In 1846, I constructed, of this Russian sheet iron, a gas-combustion furnace for organic analysis, which I exhibited to the meeting of the British Association, at Southampton, in the same year. Ever since that period the furnace has been exposed to the atmosphere, sometimes to that of a laboratory, and yet it presents only here and there small spots of rust. Other specimens of similar sheet iron, which I have had in my possession for fifteen years and upwards, remain free from rust, notwithstanding that they have also been freely exposed to the atmosphere. The metal used for the sheet iron in question is made from pig iron, either in a charcoal finery, or the puddling furnace; but, according to one account, only in the former. The pig iron is produced by smelting magnetite, spathic iron ore, and red and brown hematite, with charcoal and coal blast. For a detailed account of the process of manufacture, I must refer the members of the Institute to the pamphlet which I have mentioned; but there is one operation to which I invite their attention, and which is conducted as follows: The rolled sheets are sheared to the dimensions of 28in. by 56in.; and each sheared sheet is brushed all over with a mixture of birch charcoal powder and water, and then dried. The sheets so coated with a thin layer of charcoal powder are arranged in packets, containing from 70 to 100 sheets each; and each packet is bound up in waste sheets, of which two are placed at the top, and two at the bottom. A single packet at a time is re-heated, with logs of wood 7ft. long placed around it, and for this purpose a furnace of particular construction is employed, which will be found fully described and illustrated in the pamphlet referred to, and a copy of which I herewith transmit. It consists of a re-heating chamber above, and a fire-place below, the two being separated by a floor, containing holes, through which the gaseous products of combustion from the fire-place pass into the upper chamber. The object, it is stated, of the logs of wood is to prevent, as far as possible, the presence of free oxygen in the re-heating chamber. The packet is thus slowly heated for five or six hours, after which it is withdrawn and hammered. Now, during a considerable portion of this period, steam would continue to be evolved from the logs, and it becomes a question whether that steam may not be instrumental in forming a superficial coating of magnetic oxide of iron on the sheets of the packet, but it was not until I had read the account of Dr. Barff's process that this notion occurred to me. If it should prove to be well founded, then another would be added to the many remarkable instances in metallurgy of practices having been introduced, and long carried on, without even a suspicion of the scientific principles which they involve. Assuming the correctness of what has been asserted concerning the action of a coating of magnetic oxide of iron in preserving iron from rusting, it seems extremely probable that such action is due in great measure, if not wholly, to a peculiar physical state of the oxide. One condition is also essential, namely, the perfect continuity of the coating; for I have observed that when an article which has been coated by Professor Barff himself, and from which the oxide had been expressly removed in one or two places, was exposed to the joint action of rain and water, especially salt water, rusting speedily took place at the denuded places, and proceeded with rapidity; but whether more rapidly than in the case of ordinary sheet iron, exposed to similar conditions, I cannot state, as no comparative experiments were made. This, however, is a point which will deserve particular attention.

I trust that in submitting the foregoing remarks to the meeting of the Institute, a desire to disparage Professor Barff's application will not be imputed to me. So far from having any such desire, I have pleasure in expressing my opinion that great credit is due to the professor, both for the originality of his proposal and for the manner in which he has experimentally investigated the subject. The next example which I have to submit to the Institute of the protection from atmospheric action afforded to a metal by a coating of its own oxide is copper, and it is a very striking one. For more than a century European metallurgists have been familiar with small thin bars of cast copper, of Japanese manufacture, which present a beautiful rose-colored tint, due to an extremely thin and pertinaciously adherent film of red oxide of copper, or cuprous oxide. This tint, according to my experience, is not in the least degree affected by free exposure of the bars to the atmosphere. I have had such bars in my possession for more than thirty years, and although they have been freely exposed to the atmosphere during the whole of that period, yet they have not undergone the least change in appearance; they remain as bright and as beautifully colored as they were when I received them. Now, as every one knows, when a piece of ordinary copper is exposed to the atmosphere it speedily acquires a dark-colored tarnish. Hence the conclusion that there is some peculiarity on the surface of the Japanese copper which protects the underlying metal from atmospheric action; and that peculiarity, it may be demonstrated, is the presence of a film of cuprous oxide, in a particular physical state, which acts like varnish. The bars of Japanese copper are actually cast under water, the metal and the water, previously heated to a certain degree, being poured at a high temperature. I have fully described the process in a volume which I published in 1861, and I have recently obtained additional information on the subject from my friends, Messrs. Tookey and Godfrey, who have witnessed this singular process of casting in Japan. I have also succeeded in thus casting copper under water. It would be out of place on the present occasion, to describe the process in detail. All that need be further stated is, that when copper is so cast, under suitable conditions of temperature, it acquires a coating of cuprous oxide, which acts in the manner described. The temperature is such that the so-called spheroidal action of water comes into play, and the metal flows tranquilly under the water. The superficial oxidation is probably due to the action of a film of steam, which there is reason to believe surrounds the copper under these conditions; and when copper is heated to a high temperature in steam, the latter, as shown by Regnault's experiments, is decomposed with the evolution of hydrogen and the formation of cuprous oxide. The last example of the action in question, which I shall mention, is afforded by lead. In the collection of the Museum of Practical Geology, in London, is a number of very thin sheets of lead, coated with bands of varied and extremely bright colors. Although the atmosphere has had free access to these sheets for about thirty years, the colors are as intense and as bright as they were at first. The sheets were prepared at Mr. Beaumont's smelting works, by dexterous skimming in the process of desilverising lead by Pattinson's most original and beautiful process, and were presented to the museum by Mr. Sopwith, at that time general manager of Mr. Beaumont's mining and smelting establishments. The colors are certainly caused by extremely thin films of oxide lead of various thicknesses.

*Iron and Steel Institute.

WOOL AND RAG CLEANSING.

A PATENT has been taken in France by MM. Jourdin and Balan for improvements in the cleaning of wool of all kinds, and rags of woolen, silk, and mixed fabrics of all descriptions, by a new method of employing gases or vapors, more particularly hydrochloric acid gas. According to the specification, the gas is rendered anhydrous before it is brought into communication with the wool or rags, and these being damped, the gas, deprived of its water, has in that state a great affinity for the moisture in the materials, and as the quantity of water in them can be regulated to a nicety, so, consequently, can the effect of the gas. The wool or rags are divided into small quantities, and not massed together, in order that the gas may circulate freely through them and more effectually accomplish its purpose. The disacidulation is effected, first, by the application of air at 45° C., which, being nearly dry, absorbs the water, which retains the acid gas, and the operation is finished by means of ammoniacal gas or other alkaline agent.

WOOL GREASING.

M. BEAUCHAIN, spinner, Feuquieres, in the department of the Oise, France, is announced as the author of a new process of greasing wool, founded on the employment of petroleum, together with olive oil, or oleine. After having remarked the peculiar property possessed by petroleum, or schist oil, of liquifying old oils, M. Beauchain was struck with the idea of employing those hydrocarbons in the mixtures of oil and soap, or of carbonate of soda, at present employed.

According to his own account, the use of petroleum presents numerous advantages, the principal of which are: the rendering of even the commonest wools more supple; the obtaining of finer numbers of yarn; an economy of about fifty per cent., the petroleum taking the place of a great part of the oil, or of the oleine (we are not told the proportions); and, lastly, a very important point, the prevention of oxidation of the teeth of the card clothing.

COATING PLATES OF METAL.

IT has been the practice heretofore after pickling and washing the sheets or plates of iron or other metal to be coated to immerse them in a warm pan of grease, technically called the cold pan, instead of which Messrs. Crowther and Morgan, of Kidderminster, Eng., place the sheets or plates in a hot air chamber for the purpose of absorbing or evolving all moisture or dampness that may be left on them before immersing them in a bath of chloride of zinc, from which they restore them to the hot-air chamber to take all moisture therefrom; they then either put the sheets or plates direct into the coating metal pot, with sufficient grease or flux upon its surface, or, as usually done, immerse them in the cold pan, and then put them into the coating metal pot.

The apparatus which they employ consists in a rectangular horizontally fixed pot, sufficiently long and deep to enable them to coat sheets of plates of any required length or width; the said pot in a transverse sectional form is broad at the top for receiving finishing rollers, with short lateral rollers to prevent lateral deflection of the long rollers which work below the upper surface of the pot, below which the pot narrows gradually down to one half its depth, and then descends parallel to the bottom, leaving an opening at the end or side, whichever may be most convenient, to remove the excess of metal taken from the sheets or plates. On the front side of the pot near the top, and either inside or outside as most convenient, they supply a longitudinal shaft working in journeys, and to this shaft external weighted levers are secured, which are connected with and give motion to internal guide levers, of which there may be any necessary number, the use of which is to form guides for receiving the sheet or plate in an edgewise position, and guiding it down to the bottom of the pot to rest in a cradle, when the outside balance weights will correct the position of the internal levers, causing them to bear against the top edge of the said sheet or plate so as to keep it in a vertical position, in which position it is raised by vertical rods or chains connected with the cradle at the bottom, which is suspended to two levers, working on the axis or shaft first described; the said levers extend sufficiently over the pot that by means of a weight suspended thereon a counterpoise is created for elevating the sheet or plate to the bight of the longitudinal finishing rollers first referred to, from whence it is easily removed, the cradle being raised any additional height required by means of screws.

The motive power of the finishing rollers is derived from compound right and left worm wheels with which the rollers are connected by short spindles or couplings. Suspended to the axis of each finishing roller is a pendent receiver that collects the surplus coating metal, which is removed from the surface of the sheet or plate under operation by the action of such roller, the coating metal by reason of its gravity falling from the surface of the roller into the receiver, which performs a double duty of catching the surplus metal from the sheet or plate and feeding the surface of the rollers. These receivers are constructed with hollow chambers at the bottom, through which hot-blast is driven in a highly rarefied condition to maintain the metal in a higher degree of heat than the surrounding flux or grease.

ON THE ACTION OF VARIOUS FATTY OILS UPON COPPER.*

By WILLIAM HENRY WATSON, F.C.S.

AT the last meeting of this Association some interesting experiments were brought before you on this subject by Mr. W. Thomson. His experiments were confined chiefly to the determination of the extent of the action of various oils upon metallic copper, from the appearances of the oils and surface of the copper plates after long exposures, and from the comparative acidity of the various samples.

Having made some experiments in which I noted the appearances after exposures, and *determined* the *amount* of copper dissolved by the different oils used, I am able to speak of the rapidity with which some of them act, and now venture to bring the results before you.

The experiments were conducted as follows:—Into separate beakers 500 water-grain measures of each oil was poured, namely,—

1. Linseed oil.	6. Sperm oil.
2. Olive oil.	7. Castor oil.
3. Almond oil.	8. Neatsfoot oil.
4. Colza oil.	9. Sesame oil.
5. Seal oil.	10. Paraffin oil.

The above numbers will be mentioned farther on instead of mentioning in each case the name of the oil.

Into each of these samples of oil a piece of copper-foil exposing 8 square inches of surface was immersed. The beakers were then placed in a room above the laboratory and covered by pieces of porous paper. The appearances were noted occasionally as follows, from which it will be seen that several of the oils acted somewhat rapidly upon the copper:—

(*a*.) Examination after two days' exposure:—

1. The oil is slightly green near the copper. The copper is not changed in appearance.
2. The oil immediately surrounding the copper is of a slight green color, and the copper is a little tarnished.
3. No change in the appearance of either the oil or the copper.
4. This oil is considerably more green than in oils 1 and 2. The copper is a little tarnished, not quite so much as that in No. 2.
5. The color of this oil is now a light green. The appearance of the copper is not changed.
6. There is no apparent change in the color of either the oil or the copper.
7. Ditto, ditto.
8. A little greenness in the oil. The copper has slight irregular brown markings on its surface, evidently on the impressions left by passing through the rollers.
9. The oil is slightly a greenish yellow.
10. No change in either the oil or the copper.

Thus, with the exception of Nos. 3, 6, 7, and 10, all the samples had acted to some extent (from appearance) upon the copper by being exposed two days.

(*b*.) Examination after five days' exposure:—

1. The appearance of this oil in similar to that when last observed, but the copper has a flocculent green deposit on some portions of it which were not then present.
2. This oil is more green than when last noted, while the copper is coated with a green deposit (a thin green skin) which is easily removed by agitating the oil.
3. This oil is of a very slight green color. The appearance of the copper is not changed.
4. This oil is considerably green in color. The copper remains as before.
5. The green color of this oil is rather deeper than when last observed.
6. This oil is not changed in appearance. The copper is also as when first immersed.
7. There is a slight greenness in the oil immediately surrounding the copper. The appearance of the copper is no changed.
8. The appearance of this oil and copper is the same as when last observed.
9. The oil is slightly tinged a greenish yellow, about as when last observed. The copper remains as when first immersed.
10. No change noticeable.

Thus, by five days' exposures, all the oils had acted upon

* Read before the British Association, Plymouth Meeting, Sec. B.

the copper with the exception of No. 6 and 10 (sperm oil and paraffin oil.

(c.) Examination after ten days' exposure :—

1. The appearance of this oil and copper is as when last examined.
2. This oil appears about the same, with regard to color, as when last noticed, but there is considerably more of the green deposit on the surface of the copper.
3. This oil is of a rather deeper green color than when last examined, and the copper is slightly tarnished.
4. This oil is considerably green. The copper is a little tarnished.
5. The color of this oil is a rather deeper green than when last noticed. No apparent change in the copper.
6. No greenness in the oil, but the copper is slightly tarnished.
7. This oil is tinged very slightly green. The copper remains as before.
8. This oil is considerably green, and the copper has become a little tarnished.
9. This oil is green, but not quite so green as No. 8. The copper remains bright.
10. No apparent change.

Here it is seen that, with the exceptions of No. 10 (the paraffin oil), the appearance of each oil indicated more or less action upon the copper during the ten days' exposure. After the above observations the various samples were examined quantitatively for copper. The method adopted may be described as follows :—The copper-foil is removed from the beaker, and as much oil allowed to drain from it as possible. Any deposit on the copper and any oil remaining is removed by cotton-wool. The oil is treated with hot water to which a few drops of nitric acid had been added, and violently shaken. On being allowed to stand, solution separated from the oil is drawn off. This washing operation is repeated several times with pure water, and the whole of the washings collected. The cotton-wool used in removing the oil and any deposit from the surface of the copper is ignited, and the ash treated with a drop of nitric acid ; this is then washed into the previous washings, and the whole, by addition of water, made to measure 4,000 grains. This solution contains the whole of the copper dissolved by the oil under examination. A portion of it (generally 100 measures) is taken and diluted to 1,000, a few drops of ammonium sulphide solution added, and the depth of color produced compared with that produced similarly in a solution of copper of known strength. In the case of 100 measures of the washings being used the results are multiplied by 40, thus furnishing the total amount of copper present.

By such examination the amount of copper found in each of the samples of oil after ten days' exposure was as follows :—

1.	Linseed oil	0·3000 grain.
2.	Olive oil	0·2200 "
3.	Colza oil	0·0170 "
4.	Almond oil	0·1030 "
5.	Seal oil	9·0485 "
5.	Sperm oil	0·0030 "
7.	Castor oil	0·0065 "
8.	Neatsfoot oil (English)	0·1100 "
9.	Sesame oil	0·1700 "
10.	Paraffin oil	0·0015 "

The conclusions afforded by these quantitative results are not such as I should have drawn from the appearances of the various samples as previously noted ; for while Nos. 4 and 8 were very much more green than any of the other samples, yet the amount of copper was larger in Nos. 1, 2, and 9. From this it would appear that some of the oils form a compound with copper having a deeper green color than others, and that there may be, therefore, a greater depth of color with a less amount of copper in one oil than in another. It follows, then, that we cannot satisfactorily conclude as to the action of different oils upon copper merely from the appearance of them after being in contact with it for some time. The considerable color which very small quantities of copper produce in some oils (and especially in almond oil) is remarkable : there is therefore no difficulty in detecting the *presence* of copper, though to arrive correctly at the comparative quantity in different oils seems to be impossible, from mere observance of the appearances of the samples.

I commenced some fresh experiments with the view of exposing the samples for a much longer period, under the same conditions as the former ones. They were examined after seventy-seven days of exposure, but accidentally the sample of neatsfoot oil and the sample of sesame oil were damaged during the exposure. I am therefore only able to speak of the remaining eight samples, as follows :—

COPPER FOUND IN THE OIL AFTER SEVENTY-SEVEN DAYS' EXPOSURE.

1. *Linseed Oil.*—This oil is very green. The green compound appears to be chiefly in solution. The copper is a little tarnished. 0·5435 of a grain.

2. *Olive Oil.*—This oil is very green, more blue than that in sample No. 1, and chiefly in suspension. This flocculent compound, which covers the copper, is easily removed, and when removed the surface of the metal is quite bright. 0·2400 of a grain.

3. *Colza Oil.*—This oil is of a yellowish green color. A light transparent skin, of a green color, has become attached to the copper. 0.1400 of a grain.

4. *Almond Oil.*—This oil is very green. It is a blue-green, and suspended in the oil : there is a flocculent compound of a similar color. The surface of the foil is quite bright. 0·2200 of a grain.

5. *Seal Oil.*—Very green ; not so blue a green as that in the almond oil. The copper is irregularly tarnished. 0·0800 of a grain.

6. *Sperm Oil.*—This oil is only very slightly green. The copper has a thin green skin attached to its surface. 0·0600 of a grain.

7. *Castor Oil.*—A very slight greenness in the oil. The copper is quite bright. 0·0100 of a grain.

8. *Paraffin Oil.*—No apparent greenness in the oil. The copper is quite bright. 0·0030 of a grain.

By deducting the amounts of copper found in the different samples exposed ten days from the amounts found in those exposed seventy-seven days, we arrive at the quantities dissolved between the two dates, thus :—

1.	Linseed oil	0·2435 grain.
2.	Olive oil	0·0200 "
3.	Colza oil	0·1230 "
4.	Almond oil	0·1170 "
5.	Seal oil	0·0315 "
6.	Sperm oil	0·0575 "
7.	Castor oil	0·0035 "
8.	Paraffin oil	0·0015 "

The action of the olive oil was greatest at its first exposure, for during the first ten days it had dissolved 042 of a grain, while in the following sixty-seven days it only dissolved 0·02 of a grain of copper, according to the experiments in the first and second series.

In conclusion, the results of my experiments show that, of the oils examined, paraffin oil and castor oil, when pure, have least action upon copper, while the action of sperm oil and seal oil is but slight. The rest of the oils taken all act considerably, and the action of linseed is especially great.

Braystones, near Whitehaven, July, 1877.

DETECTION OF FATTY MATTERS FRAUDULENTLY INTRODUCED INTO BUTTER.

C. HUSSON.

Natural butter is known to be of good quality by treating a given weight with 10 parts of a mixture of equal volumes of ether at 66° and of alcohol at 90°. The solution is effected by placing the mixture in the water-bath at the temperature of 35° to 40°, and then letting it cool down to 18°. After twenty-four hours genuine butter should leave a deposit of pure margarin, which must not exceed 40 per cent. nor fall below 35. An increase in this figure proves sophistication by means of tallow, whilst a decrease shows the presence of "margarin Mouries," of lard, or of goose-grease.

EXPERIMENTS RELATIVE TO THE FORMATION OF ULTRAMARINE.

M. J. F. PLICQUE.

The majority of the hypotheses which have been framed concerning the chemical constitution of ultramarine are based upon analyses executed with products obtained industrially. The centesimal composition of the substances reacting is always rigorously determined, but, as during this manufacture a part only of the components serves to produce ultramarine, whilst the remainder yields soluble products, ultimately eliminated by washing : as, further, the proportions of silica and alumina may vary in the mixtures without the blue color being sensibly affected, the analytical results are so complex that it is difficult to deduce from them a rational formula. The author has sought to realize the synthesis of ultramarine by a laboratory method which would enable him to employ chemically pure silica, alumina, soda, and sulphur in the formation of the blue color. On examining in what proportion the silica, alumina, and soda should combine, he observed that the insoluble alumino-silicate of soda obtained by Deville presents the same proportions of silica and alumina as the mixtures employed in certain establishments for the production of blue ultramarine. This silico-aluminate of soda contains 44.6 of silica, 26.4 of alumina, 16.3 of soda, and 12.7 of water. The ratios of oxygen are as 6, 3, 1, 3. On heating it for thirty hours in a muffle with 25 per cent. of sulphur and 2 per cent. of resin, an ultramarine of a perfect shade is obtained. In order to examine the different reactions produced, the author operated in the following manner : Silicate of soda prepared with pure materials, and aluminate of soda likewise pure, were mixed in equivalent solutions. The product obtained on collecting the precipitate upon a filter, and drying rapidly at 110°, always contained an excess of soda, and presented the following composition :—

Silica	31·105	31·150
Alumina	18·402	18·410
Soda	29·367	29·359
Water	20·750	20·749
	99·624	99·688

The material employed in these experiments contained therefore 60·86 per cent. of the silico-aluminate of soda, in which the ratios of oxygen are 6, 3, 1. Upon this molecule ($3SiO_2Al_2O_3NaO$) he caused to react sulphuretted hydrogen and sulphurous acid at the temperature of dull redness, about 750°. He also used sulphide of carbon in place of sulphuretted hydrogen, and by operating for several days he hoped to obtain the crystalline ultramarine of MM. G. Grünzweig and R. Hoffman. 100 parts of silico-aluminate of soda heated for ninety hours in the vapour of carbon bisulphide yielded 96·840 of a sulphuretted product, white, slightly yellowish, which on exposure to moist air absorbs oxygen with rapidity and becomes bluish, sulphuretted hydrogen being developed at the same time. This 96·840, heated for ten hours in sulphurous acid until the weight became constant, gave 107·6 of ultramarine blue, the sulphurous acid being absorbed in very large quantity; and during this second stage of the operation a large proportion of sulphur was evolved and deposited in the colder parts of the porcelain tube. The blue thus produced at the temperature of about 750° contains no free sulphur, but 41·3 sulphate of soda, which can be eliminated by washing with boiling water. No soluble sodium sulphide could be detected. This ultramarine, when carefully washed with distilled water, was of a very deep and pure blue, but did not present the violet tone of the ultramarines of commerce. Its composition was found to be as follows :

Silica	46·810	$3SiO_2$
Alumina	27·702	Al_2G_3
Soda	17·280	NaO
Sulphur	5·217	
Oxygen	2·991	cal. as loss.
	100·000	

On examining these figures we see that the silica, alumina, and soda found in the blue are still in the same proportions as in the insoluble silico-aluminate of soda. The excess of soda contained in the precipitate employed has been entirely converted into sulphate of soda. The author not having succeeded in obtaining crystallized ultramarine, has not been able to assign a formula to this compound, but he infers from his experiments that :—Contrary to the assertions of certain German authors, ultramarine contains no nitrogen. Blue ultramarine, properly so-called, is formed by an oxy-compound of sulphur, which is probably fixed both upon the sodium and the aluminum. During the first period of the operations, the passage of the sulphide of carbon, the sulphur is substituted for a part of the oxygen in the molecule of the silico-aluminate of soda, and in the excess of soda it completely replaces oxygen. The sulphurous acid, reacting upon this first compound, takes the place of a part of the sulphur of the molecule of the sulphuretted silico-aluminate of sodium, and destroying the sodium sulphide not chemically combined with silica and alumina, converts it into sulphate of soda. To obtain these results it is necessary to keep the materials for several days in the vapor of carbon bisulphide at 750°. If the temperature is raised to 1000° we obtain a black agglomerated product, which on treatment with water evolves sulphuretted hydrogen, and is transformed into ultramarine-blue. This product evidently contains Fremy's aluminum sulphide, and this experiment renders it conceivable that a part of the sulphur in ultramarine may be found in the state of aluminum oxy-sulphide. If instead of sulphuretted hydrogen and sulphurous acid we use seleniuretted hydrogen and selenious acid, a red compound is produced analogous to the blue, whilst tellurium similarly applied gives a yellow product.

ACTION OF CYANOGEN ON ALBUMIN.

When a current of cyanogen is passed into a solution of albumin, a flocculent substance separates; the supernatant liquid, according to O. Löw, coagulates on the addition of alcohol and nitric acid, while aceti acid throws down a considerable precipitate (*Jour Prakt. Chem.*, 1877, xvi., 60). The last-mentioned product was found on analysis to be identical with the flocculent body first alluded to : to be, in short, a body consisting of albumin, cyanogen and water the quantitative relations of the ingredients varying with the quantity of the substances which are brought together. In one experiment the body isolated consisted of one molecule of albumin, $C_{72}H_{112}N_{18}SO_{22}$+2 mol. of cyanogen, C_2N_2+3 mol. of water; in another, one molecule albumin +4 mol. cyanogen + 8 mol. of water; and in a third of one molecule albumin + 8 mol. of cyanogen + 16 mol. of water. When acted upon by alkalies, these bodies lose a part of their cyanogen and the whole of their water, ammonia is set free, oxalic acid is formed, and compounds containing an abundance of nitrogen are likewise produced. During a more recent inquiry it was found that the liquid from which acetic acid had thrown down a precipitate—a liquid which, it should be mentioned, emitted a powerful odor of hydrocyanic acid—deposited on evaporation spherular masses of a yellowish-colored body, which was sparingly soluble in alcohol and cold water, and on the application of heat evolved hydrocyanic acid, while a white substance sublimed which was found to be soluble in cold concentrated sulphuric acid, and to be deposited from that liquid as a yellow powder on addition of water; with aqueous solutions of nitrate of silver or basic acetate of lead, it formed bright-yellow precipitates; and when warmed with caustic soda it underwent decomposition, oxalic acid being formed and ammonia evolved in considerable quantities. Löw has named this body *Oxamoidin;* it appears to have the composition $C_{14}H_{22}N_{11}O_{16}$. A quantitative determination of the ammonia and oxalic acid liberated during the decomposition points to the probability of the separation from the oxamoidin under these circumstances of a compound, having the formula $C_5H_{11}N_5O_5$; another body having the composition $C_5H_7N_3O$, or more probably $C_5H_7N_3O_2$, being likewise isolated. If the compounds which are formed by the action of cyanogen on albumin be boiled with very dilute solution of soda, they evolve ammonia, and, on treatment with acetic acid, carbonic acid, hydrocyanic acid and sulphuretted hydrogen, considerable quantities of oxalic acid remaining in the solution, together with a canary-yellow body, which separates on the addition of acetic acid, and to which the author has given the name of *cyalbidin.*

FREEZING POINT OF ETHER.

By A. P. N. FRANCHIMONT.

Fourcroy and Vauquelin have stated that ether begins to solidify at −31°, and forms at −44° a solid, crystalline mass. This statment is found in many modern books, although Thénard and Mitschell showed that pure ether does not solidify at these temperatures, nor even at −99° according to the latter. The author has found that this is correct; pure anhydrous ether contained in tubes closed with drying tubes, remained quite mobile in a mixture of solid carbon dioxide and ether. But if the tubes were only closed with corks, moisture entered, and white flakes separated at −45°. In ether containing water a larger quantity of these white crystalline flakes is formed, but it was impossible to solidify completely ether which was saturated with water, showing that it does not form a hydrate.—*Deut. Chem. Ges. Ber.*

A NEW SERIES OF ACID SALTS.

By A. VILLIERS.

By leaving hot solutions of sodium acetate containing water and acetic acid in different proportions to cool, crystals are obtained in which acetic acid plays a part analogous to that of the water of crystallization, which in many instances it replaces in equivalent quantities. These crystals, when exposed to the air, rapidly effloresce by losing acetic acid and water. Fragments of the crystals thrown to the surface of water exhibit movements of rotation and translation, which are more rapid as the quantity of contained acetic acid is greater. The author has obtained sodium biacetate in cubic crystals, corresponding with the potassium salt already known, and he has also prepared divers new acetates of other metals.—*Compt. Rend.*

PRESENCE OF BENZENE IN COAL-GAS.

By M. BERTHELOT.

The presence of benzene in coal-gas, has been verified by the action of fuming nitrate acid upon the gas, and the subsequent reactions of the nitro-benzene formed. It is also found that nitric acid does not act upon ethylene in an appreciable manner, so that this method of estimating the quantity of benzene is not vitiated by the presence of ethylene. Experiments show that only traces of benzene and ethylene are soluble in monohydrate of sulphuric acid ($HSO_4.H_2O$, sp. gr. 1.781 at 14°), whilst on the other hand propylene and acetylene are completely absorbed, the former in a few moments, the latter in 25 minutes. The illuminating power of gas is due mainly to the presence of benzene, and it would seem that the illuminating power of a flame is not due to the numerical relation of the carbon to the hydrogen, but, as Franklin has shown, to the condensation of these elements in the unit of volume.—*Compt., Rend.*

METANETHOL CAMPHOR.

By P. PERRENOUD.

The exact relationship between the four isomeric bodies, anethol, metanethol, anisoin, and metanethol camphor, is a question still of much uncertainty. With a view to throwing additional light upon the subject, the author has determined to study metanethol camphor. Metanethol camphor was prepared by heating fused anethol, with three and a half times its weight of powdered zinc chloride, and distilling in a current of steam. Metanethol camphor forms, when pure, long glittering needles, melting at 132°, and boiling above 300°, whilst partially subliming at a lower temperature. It is very easily soluble in boiling acetic acid, not so easily soluble in hot etner and alcohol, readily soluble in chloroform, carbon bisulphide, benzene, and concentrated sulphuric acid, slightly soluble in cold ether and alcohol. It is insoluble in water and sodium hydrate solution. It is readily acted on by nitric acid, and forms substitution compounds with bromine. These are being further examined. On analysis metanethol camphor yields numbers closely agreeing with the formula, $C_{10}H_{12}O$. The view taken by Gerhardt that anethol and metanethol camphor are isomeric is therefore fully confirmed.

With concentrated sulphuric acid, metanethol camphor forms a sulpho-acid, $C_{10}H_{11}(SO_2)O.H$. The calcium salt forms large plates, containing one molecule of water, readily soluble in water and alcohol. The barium salt crystallizes in long, glittering needles, uniting in groups, and containing 1 molecule of water of crystallization. They are slightly suluble in absolute alcohol, more soluble in dilute alcohol, and readily soluble in water. The sodium salt forms needle-like crystals. By acting with phosphorus pentachloride on sodium metanetholcamphorsulphate, a chlorinated body, of the formula $C_{10}H_{11}O,SO_2Cl$, is obtained. It forms fine crystals, melting at 182—183°, and readily soluble in ether, chloroform, and acetic acid.—*Liebig's Annalen.*

EXTRACTION OF CAFFEINE.

By LEGRIP and PETIT.

After having tried various methods for the extraction of caffeine, particularly that recently recommended by Cazeneuve and Caillol, the authors have adopted the following, as giving the best results. Coarsely powdered tea is covered with twice its weight of boiling water, left for a short time at a gentle heat, and the resulting moist powder exhausted with chloroform. When the latter is colorless, the exhaustion is complete. On distillation of the chloroform extract, an oily residue and caffeine remain in the retort. On treating this residue with a suitable amount of boiling water containing a small quantity of animal charcoal, then filtering and cooling, magnificent crystals of caffeine are obtained. The tannin is retained by the water, the caffeine being dissolved in the chloroform. No satisfactory results were obtained by treating the powdered tea directly with the chloroform.—*Bull. Soc. Chim.*

COLORING MATTER OF THE PETALS OF ROSA GALLICA.

By HAROLD SENIER.

The petals were digested with ether, and the solution filtered, by which means quercetin and fat were removed. Alcohol was found best to extract the color, producing a colorless solution, which reddens with age; the aqueous extract is, however, colored. From the alcoholic solution, the coloring matter was precipitated green by lead acetate; it was then washed and dried, and decomposed in the one case by sulphuretted hydrogen; in the other by sulphuric acid, and then yielded a bright red solution. Dilute acids deepen the color; alkalies change it to a deep red, with a green fluorescence; potash, soda, and ammonia yield crystalline compounds; fine octohedrons were obtained, when potash and soda were both employed. Alkaline carbonates act in the same manner as the alkalies, except that the change of color is accompanied by effervescence. Sulphuretted hydrogen changes the red to the brown, and stannic chloride from red to dark magenta; on boiling with metallic mercury, a dark violet is produced; mercuric nitrate and chloride give a white or pinkish precipitate; barium or calcium hydrate a yellowish green precipitate, turning brown when dry. The red coloring matter in solution has an acid reaction, and is not altered by hydrogen peroxide. The lead salt appeared by analysis to consist of $Pb_3C_{21}H_{20}O_{20}$. Dissolved in alcohol, the extract gives absorption bands, of which a sketch is given in the paper. With a solution rendered acid by sulphuric acid, absorption takes place between D and F, having its maximum about half way between E and F. A solution rendered alkaline by ammonia absorbs light partially between *a* and *e* and from G to beyond H; and a solution treated with stannic chloride absorbs light from B to G.—*Pharm. J. Trans.*

ZINC IN ANIMALS AND PLANTS.

By G. LECHARTIER and F. BELLAMY.

The authors have found zinc in the human liver, in the liver and muscles of the ox, in eggs, and in wheat, barley, maize, and other vegetables. A human liver, weighing 1780 grams, yielded 2 centigrams of zinc oxide, and 913 grams of lean beef gave three centigrams of the oxide. Further researches are required before it can be affirmed that zinc is universally present in animal and vegetable bodies, but the facts here pointed out obviously possess a high importance in relation to toxicological investigations.

SACCHARIFYING FERMENTS.

By J. SEEGEN and KRATSCHMER.

The authors endeavored, by applying the method used by v. Wittich for obtaining the pancreatic ferment, to isolate the ferment of the liver. For livers containing much sugar, they found the method inapplicable, as sugar passes over in the glycerin-extract, and even when the latter was free from sugar, it soon gave, on dilution with water, a sugar-reaction, which could be only accounted for by the presence in it of both glycogen and ferment. The authors confirm the observation of Abeles that in a liver free from sugar, which has been boiled, formation of sugar occurs, on standing in contact with the air, and that, therefore, a saccharifying substance becomes active. Von Wittich and Lepine had already shown that in many animal tissues a saccharifying substance is present. The authors experimented with muscle, kidney, and brain; their experiments differed, however, from those of the above observers in the fact that the tissues were first *boiled*, then well washed and, the absence of sugar having been ascertained, were cut into small pieces and placed in a solution of glycogen. After some time, sugar always appeared, sometimes after only a few hours. The fact that the above organs had the one thing in common, that they were albuminous tissues, led the authors to experiment with chemically pure serum-albumin, egg-albumin, casein, and fibrin. These experiments showed that diastatic action is connected with an albuminous body soluble in water.

The results of the authors' experiments may be summarized as follows.—

(1.) The albuminous tissues of the body, as well as all other albuminous bodies, which are soluble either partly or entirely in water, when in contact, for a longer or shorter time, with glycogen, possess the property of exerting a saccharifying action. By boiling the aqueous solution of the albuminous bodies, the diastatic action is momentarily arrested, but appears again after the space of two or three days. The minutest quantities of soluble albumin are sufficient to exert this sugar-forming action.

(2.) The action of these albuminous bodies on glycogen is qualitatively identical with that of saliva, and of pancreas extract. There is, however, considerable difference both in the quantity and also in the rapidity of the action. The time required is longer, and the sugar formed by the action of albuminous bodies is much smaller in quantity than in the case of saliva or the pancreatic extract. The formation of sugar in a *boiled* liver is to be referred to the diastatic action of the albuminous tissue contained therein; whereas, in fresh *unboiled* liver, it is highly probable that, as in saliva and the pancreatic juice, a diastatic ferment is present in large quantities.

(3.) No method is known at present by which liver-ferment can be isolated. By all methods hitherto employed, glycogen is first extracted, and this contains, mixed with it, a diastatic element.

(4.) The authors' observations confirm the fact that in a pure solution of glycogen in glycerin, ferments are inactive. The formation of sugar occurs immediately when water is added to the mixture.—*Pflüger's Archiv. fur Physiologie.*

DETECTION OF ALUM IN FLOUR.

By J. C. BELL.

50 grams of flour are mixed with 50 c. c. of water, 0·5 c.c. of logwood solution, and 5 c.c. of ammonium carbonate solution are added. The color of the emulsion becomes lavender-blue, in place of pink, if $\frac{1}{15000}$th part of alum is present.—*Analyst.*

ESTIMATION OF PIPERINE IN PEPPER.

By CAZENEUVE and CAILLOL.

The authors have applied the chalk method with great success to the extraction and estimation of various alkaloids. They therefore tried it in the extraction and estimation of piperine in pepper in the following way:—Ground pepper is treated with twice its weight of slaked lime and a sufficient quantity of water, the whole being heated to boiling for a quarter of an hour. The piperine is in no way altered by this treatment. The solution is then evaporated to dryness on the water-bath, and the powder exhausted in a suitable apparatus with commercial ether, from which the piperine can be obtained nearly pure on evaporation, Piperine forms large crystals of a faint straw yellow color.

To obtain it perfectly pure, it must be dissolved in alcohol and crystallized. The crystals obtained from the ether are, however, pure enough to weigh, and thence determine the amount of alkaloid in the pepper. The authors operated on 10 grams of pepper. The piperine from the ether solution is dried at 100° and weighed:

Sumatra pepper.......	gave 8·1	per	cent.	piperine.
Black Singapore do....	" 7·15	"	"	
White do. do	" 9·15	"	"	
Penang...............	" 5·24	"	"	

The superior richness of the white Singapore pepper in piperine is due to the absence of the inactive pericarp in that variety.—*Bull. Soc. Chim.*

WINTER COLORING OF LEAVES.

By G. HABERLANDT.

THE changes of color in the non-deciduous leaves depend upon three distinct physiological processes. The yellow color is due to the decomposition, by light, of chlorophyll existing after its reproduction has ceased.

The brown color is produced by the formation of a brown-yellow coloring matter from the chlorophyll. Its immediate cause is the cold; the light merely treating the substances which, upon the appearance of frost, act upon and modify the chlorophyll. The subsequent greening of brown twigs must depend upon the mere disappearance of this coloring matter, into which undoubtedly only a small part of the chlorophyll had been changed.

The red color is traceable to the presence of anthocyan. It sometimes depends on light, at other times not, and generally follows the commencement of rest in vegetation.

Transition tints depend upon combination of these colors. —*Chem. Centr.*

INFLUENCE OF COLD ON MILK.

BY preserving milk in ice-water at 1° to 2° for some time, it remains perfectly sweet and unaltered for 14 days, as stated by Soxhlet (*Wein. Landw. Zeitung*, 1876, 264). After 17 days it began to taste slightly sour, the rancid taste increasing, until after 28 days the milk was curdled when boiled. After 34 days it curdled in ice-water. Considerable quantities of volatile fatty acids had been formed by oxidation of the milk-fat in the air. This formation of acids is quite different from the formation of lactic acid, which takes place by decomposition of milk-sugar, by means of an organized ferment at a higher temperature, but is retarded by the low temperature of Swartz's method, whereas the oxidation is not prevented by cold.—*Dingl. Polyt. J.*

CHEAP GREENHOUSES.

A CORRESPONDENT of the *Country Gentlemen* says: There is one factor in the count that we seldom see mentioned in the construction of cheap greenhouses, though it is well known to all practical gardeners, and should be better understood by the amateur. The sun's light, and more especially heat, are the two most essential requisites that we seek to use in all glass houses. To get the full benefit of these requires some attention to fixed and invariable natural laws that we often see entirely ignored in greenhouse architecture. They are set at all points of the compass, just as suits the caprice or convenience of the builder, when they might be set right as well as wrong, did the owner recognize the difference. Of course, in many cases where the space is contracted, and position defined by previous structures, our rules will not apply.

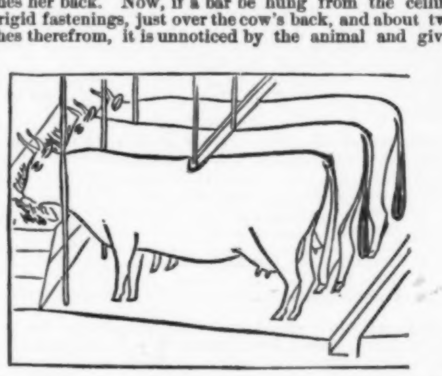
The law of refraction of light and heat to which we refer teaches us that, to derive the greatest benefit from the sun's rays, they should strike the glass at an angle of 90°. To utilize this force, and make the most of this heat, in the morning and evening of our short winter days, when it is specially needed, demands that greenhouses have the glass sloping due east and west, or with the house running due north and south. The sun then reaches its maximum power upon the glass on the east side, from 9 to 10 o'clock, A.M., and again upon the west side from 3 to 4 o'clock, P.M., and does not entirely cease to heat the interior of the building until it sets. At noon-day the heat is not made more excessive than is desirable, as the sun shines upon both sides of an oblique angle. Where the house is set in an opposite direction, the north side is practically useless, as far as any heat to be derived from the sun is concerned, and the sun is most powerful upon the south side in the warmest part of the day, when its heat is least needed. A double-span house is in this case little better than a lean-to or single slope roof. In the case of growing grapes under glass, those on the south shade the vines on the north of the house, so as to very much impair their value.

Several years of practical experience and observation have led me to believe that there are now many tons of fuel needlessly used, where the sun would do the work better, if we would give it the chance.

Our high winter winds, generally from the northwest, and sometimes falling to a temperature many degrees below zero, are the most severe upon all sorts of buildings, and especially greenhouses, in winter. To avoid this is a leading motive in having as much of the house under ground as practicable, and the glass roof no higher than is necessary for the plants to be kept. A blank wall exposed to the weather on the outside is a great mistake in all houses to be kept warm during the winter. The protection of a hill sloping to the south and east may make this form of house desirable for some purposes, and compensate for loss of light on one side. G.

LABOR-SAVING COWS.

We present in a rough sketch a method we have seen in use for aiding in the keeping of stalled cattle clean. It is founded on the observed fact that when a cow dungs she arches her back. Now, if a bar be hung from the ceiling by rigid fastenings, just over the cow's back, and about two inches therefrom, it is unnoticed by the animal and gives



no trouble. When she tries to perform the operation, however, her back comes into contact with the bar and she is prevented. Very soon, she learns to step back before dunging and if she by chance forgets herself, there is the bar to remind her. This device has worked well in the one case we have seen, at Mr. Thompson's, Southboro, Mass., who has clean cattle, and spends very little time in cleaning them.—*Scientific Farmer.*

HOP CULTURE IN NEW YORK

By EMERY GILBERT BISSELL, PH. G.

HOP culture in the United States was commenced in Virginia about 250 years ago, in 1857 the industry was encouraged by legislative enactments. The culture of the crop in that State was not a success, the quality produced being far inferior to that of the old world. After the failure to produce a good quality in Virginia little attention was paid to the growing of hops in this country until within the last seventy-five years, and the most we can learn from census reports is that they have been grown, more or less, in nearly every State and Territory in the Union—Florida, Dakota, and New Mexico being the only exceptions. It is within the past thirty-five years that hops have assumed their present commercial and agricultural importance in the United States, and during that time the culture has increased at a surprising rate, while in England and Germany the increase has been very slight during the past seventy-five years. Some idea may be formed of the growth and importance of this interest in the United States from the following statistics, taken from the census reports, which, allowing 200 pounds to the bale, show that there were produced in this country in 1840, 6,196 bales; 1850, 17,485 bales; 1860, 54,960 bales; 1870, 127,283 bales. Thus far New York has led all other States in this branch of agriculture; probably at least four-fifths of all the hops ever grown in this country have been produced in New York. In certain sections of the State the crop is the chief one of the farmer, and the sale of it the leading business of the community. In the year 1860 the counties of Oneida, Madison, Otsego and Schoharie are said to have produced more hops than were grown in the United States outside of New York. In 1875 the two counties Oneida and Madison produced something over 40,000 bales, probably about one-third the entire crop of the country. The export from the port of New York, year ending August 31, were, in 1869, 69,463 bales; 1870, 56,543 bales 1871, 24,577 bales; 1872, 6,095 bales; 1873, 9,315 bales; 1874, 1,638 bales; 1875, 15,995 bales; 1876, 46,116 bales. The imports to the port of New York, year ending Aug. 31st, were, in 1869, none; 1870, none; 1871, none; 1872, 5,800 bales; 1873, 20,885 bales; 1874, 13,444 bales; 1875, none; 1876, none.

The American hop is of fine quality, indeed it is claimed that, when our hops are properly picked and dried, no country produces a finer article. The quality of hops can be readily determined by their general appearance, odor and

amount of lupulin contained in them, the best being free from rust or mould, the bracts of a bright yellowish-green color, and showing none of the dark spots produced by the hop-leaf louse (Apis humuli). The odor of hops is peculiar, powerful and penetrating, yet to most people agreeable it is due to a volatile oil. In judging of hops little or no attention is paid to their taste. Climate appears to have as much influence on the hop as soil. A hot, scorching sun is unfavorable, because it causes the strobiles to dry before maturity. It has been observed that favorable weather for corn is not the best for hops; thus in the fall of 1875 the corn crop of central New York was much smaller than usual, while the yield of hops was usually large. Damp, muggy weather is very unfavorable, causing the strobiles to mould, particularly if they have been damaged by the hop-leaf louse. Temperate weather and a clear atmosphere are the climatic requisites for a successful cultivation of the crop.

Two varieties of the hop are principally grown in New York, being known as the large and small cluster. No particular difference is to be seen in these two varieties, excepting the one is larger than the other, and no difference is known in quality. Besides these two varieties, a third, known as the Palmer Seedling, is now coming into quite extensive cultivation. This variety was first obtained from the seed, by the late Charles Palmer, of Waterville, N. Y. some twelve or fourteen years ago, and now under successful cultivation in New York, some of the Western States and in Canada. This variety does not yield quite as well as the other kinds; no difference, however, is to be noticed in the vine, and the hop itself is of large size and fine quality, hardly to be distinguished from the large cluster. The peculiarity of this hop is that it matures some three or four weeks in advance of the ordinary kinds, thus enabling the grower of them to get his crop into market before the ordinary kinds are fit to pick.

Hops are cultivated, picked, dried and baled in New York after much the same manner as described by Mr. Wm. H. Ramsey in his very interesting paper entitled "Hop Culture in Wisconsin," and published in the "*American Journal of Pharmacy*," 1875, page 241.

In starting new yards the hills are usually placed seven feet apart one way by eight the other. Some growers, however, place the hills only six feet apart in each direction. As the hop plant does not yield the first year, corn or potatoes are planted among the young vines; the latter crop is the better for the hops, because it gives them more exposure to the sun. The second year the vines are trained on poles or strings prepared for the purpose; two poles are generally used to each hill, but sometimes three are used, and growers who set the hills only six feet apart place but one pole to each hill. The poles are set immediately after grubbing. Close cultivation pays best, and after the poles are set the yards may be tilled nearly every day to advantage; the yard in which not a green thing aside from the hop itself is to be seen being the most productive.

When the vine has grown two or three feet in length, usually about the middle of May, tying is commenced. This work is largely done by women and girls, who at this time go through the yard, and, with strings or rushes cut for the purpose, tie usually two vines to each pole; the remaining vines, of which a dozen or more often spring from a hill, are after a time removed, thus throwing the whole vitality of the plant into the two vines which ascend the pole. The largest of the young vines are among those removed, as they run more to vine and are not as productive as those of a medium size. The tying has to be kept up from time to time, until the vine is well up the pole.

The stringing of hops is of late coming much into vogue. When hops are to be trained in this way they are set out the same as though they were to be poled. To the first row of hills are placed stakes four or five feet in length, pieces of broken poles being generally used for the purpose; to the next row are placed long poles alternately with stakes; to the third row are placed stakes, as in the first; to the fourth row stakes and poles, as in the second; and so on through the yard. From each stake are run two strings, nearly to the top of the neighboring poles; two vines are usually run on each string, and two on the poles. This kind of training is called tent fashion, from the resemblance of the yard to a series of tents, and is the usual way of training the vine on strings. Other ways have been tried, but this method has thus far proven the most successful. The chief advantage of this method of growing hops is that it is much the cheapest way, only one pole having to be provided where sixteen are used if the hops are poled in the ordinary way. The kind of twine used with the best satisfaction is coarse wool twine; this costs about eleven or twelve cents per pound, and it takes from fifty to sixty pounds to the acre; the stakes used are worth two to four cents each. When hops are poled in the usual way it takes about 1,500 poles to the acre; these cost from about twelve to fourteen cents each. Another advantage claimed in stringing hops is that they are not as liable to be damaged by winds; the strings giving more than poles before the storm, prevents the hops from being whipped together. The vines, however, do not climb strings quite as readily as poles, and consequently it is more work to keep them tied. Another disadvantage is that they are not quite so conveniently picked as from the poles, and it may be also mentioned that the idea prevails among some growers that the vine trained on strings is not quite as productive.

After hops have got a fair start in the spring the growth of the vine is generally very rapid; a number of vines watched by the writer grew, on a average, more than six inches a day in succession, and in favorable weather exceptional vines have been known to grow ten or more inches in twenty-four hours. But the hop is about the most uncertain crop; the prospects of a yard may be wholly destroyed in a single hour by hail, which proves destructive to the vine; heavy winds at times lay the poles level with the ground; then may come lice or blight, either of which is liable to destroy the crop in a few days' time; only after picking is well advanced is there a certainty as to what the crop will be.

The hop-leaf louse (Apis humuli) is the great dread of the hop grower; more hops are probably destroyed by this insect than by all other causes combined; indeed growing yards are now scarcely to be found where the insect does not flourish in considerable numbers. The hops are sometimes destroyed in the burr by this insect, but most generally they enter the strobile after it is formed and nearly ripe, and destroy the hop by piercing the bracts, thus allowing the juice to exude, which together with excretion of the insect causes the hop to mould, and unless they are very soon picked and dried the inside turns nearly black; the hop then acquires a disagreeable odor, and is rendered entirely worthless.

Blight, or rust, is a disease which attacks the vine generally while the hop is in the burr, and gives it the appearance of having been scorched by fire; the hops on such vines do not fully develop.

Hop picking is usually commenced about Sept. 1st; many of the pickers are brought from neighboring cities, and boarded by the growers who employ them until the hops are gathered, some of the larger growers having at this season a hundred or a hundred and fifty hop pickers to provide for.

The crop is necessarily gathered before entirely ripe, because if left to fully mature on the poles great loss occurs from their being then easily shaken from the vine or whipped to pieces by winds; many growers, however, greatly damage their crop by picking when too green; when this is done, the hop, of course does not contain its full amount of lupulin, which is the valuable portion; moreover, the roots are much damaged by a too early cutting away of the vine; indeed, it appears the vine is usually cut away too soon for the good of the root; as in cases where the crop has been so damaged as not to be picked, the vine not being cut away until completely dead, the yield the following year has been found unusually large.

Hop picking generally lasts from two to three weeks. The boxes, as fast as they are filled by the pickers, are emptied into sacks; they are then taken and placed in kilns, where they are dried by artificial heat. After drying the hops are pressed, by lever hand presses, into bales of about two hundred pounds each; they are also pressed into small packages of from ¼ to 1 pound. This is a convenient form for the druggist; but, as far as the observation of the writer goes, most all of the hops put up in this form are of very inferior quality, and many of them entirely worthless; in fact, this method seems to be taken for disposing of utterly worthless hops, which could not be sold, at any price, in any other form.

The actual cost of raising hops is, on an average, about ten cents per pound. Their price is as variable as the crop is uncertain, having ranged within the past few years from the actual cost of production to fifty and even sixty cents per pound; most years the crop brings a price which is remunerative to the grower, and, in fact, the culture of hops, if carried on for a succession of years, is said to pay better than most any other kind of farming.

COST OF RAISING POTATOES.

THE recent discussions in the *Country Gentleman* on the cultivation of the potato suggest some remarks of our own, chiefly the result of experience, which we offer to our readers, not for the purpose of settling any point, but for promoting further enquiry and continued experiment. There is no question that potatoes may be raised at a low cost, provided the ground is in good condition, and the work performed mostly by horses with labor-saving implements. The land, to be in good condition, must be free from the seeds of weeds, so as to require no hand-hoeing, but to admit of frequent horse-cultivation: and it should be deep and friable enough to facilitate easy planting and digging. It must of course be well underdrained, either naturally or artificially, especially if inclining to clay; and it should be deep enough to hold moisture in time of drouth. A case was met with a few years ago, showing the value of a deep soil, where a row of potatoes was planted on a covered drain, and the season being dry, it yielded nearly double the amount from parallel rows, the mellowed subsoil in digging the drain making all this difference.

There is no doubt that much of the expense of planting may be saved by using the recently improved potato planter, which cuts and drops the pieces and covers them, all under one operation, care having been taken to select, for seed, potatoes of nearly equal size. When the owner can give his personal attention to see that this machine is constantly in first-rate working order, and does its work perfectly, it will plant nearly as evenly as by hand; but hired men do not usually give that constant care to it, and they make less perfect planting than by hand. Another difficulty in its use, is that it does not commonly cover the seed so deep as we find conducive to a good crop. For small plantations therefore of only one or two acres, we prefer doing the planting by hand. Two men will cut and plant in drills, with the pieces a foot or fifteen inches apart, about half an acre a day, and do the work well, covering evenly all in the best manner. On most soils we find a depth of four or five inches, decidedly better than only two or three inches in the product.

The subsequent cultivation is an important matter, so far as economy is concerned. If the soil is quite free from weeds and thin seeds, no hand-hoeing is necessary; but as with all other plants, frequent stirring of the soil accelerates growth, and the cultivator should therefore be frequently passed. But as it is rare that the soil is perfectly clean, we keep all weeds out of the way by using the smoothing harrow a few times while the plants are small - once just before they come up, and about twice or three times more by the time they are six inches high. The teeth pass among the plants, and clean out all the small weeds, leaving the rows as clean as could be effected by any hand-hoeing or hand-weeding. This is also the mode adopted by a correspondent as described in a recent number of the *Country Gentleman*, p. 695, 2d column. But we do not adopt his mode of ridging the rows or banking up with a corn plow, as from repeated experiments, by measuring the product, we find banking or hilling invariably lessens the crop, and experiments in Europe have more recently given similar results. When the potatoes, therefore, are so large that the smoothing harrow injures them, we simply pass the common one-horse cultivator frequently between the rows. A double cultivator, drawn by two horses, would be more economical of labor, in large fields.

We have no "trouble" with the Colorado beetle, and only a moderate amount of labor. By watching closely for their early appearance, Paris green and water from a watering pot made on purpose makes satisfactory work at small expense.

On light soils, the digging may be performed by any of the cheaper diggers, which are made with prongs projecting in the rear of the plow; the soil being friable, the tubers are thrown to the surface. On heavy or adhesive soils, none of these implements work well, and we use a common plow, running just deep enough to invert the potatoes, picking up all thus brought in sight and bringing the rest to the surface with a common harrow. By a little practice, this mode makes clean gathering, not half a bushel per acre remaining in the soil. Two men usually harvest sixty bushels a day.

Early digging, or as soon as the tops are dead, has some advantages. Before the autumn rains set in, the potatoes come out clean. It is hardly safe to put them in a cellar so early, as the rot sometimes attacks them after being thus deposited. We prefer to place them on a barn floor, slightly covered with straw or corn stalks to prevent the light from making them strong, where they remain cool and dry till removed to the cellar in November. They should be placed in bins, some inches above the bottom of the cellar, with small openings in the bottom to admit some circulation of the air. The large tree-boxes used by nurserymen, with a few openings as described, answer a good purpose. They may be placed one above another, separated a few inches with blocks or scantlings.

We do not give this mode of raising and managing the crop as one to be copied or adopted in unlike circumstances, but as suggesting variations when advisable. In giving the following estimate or statement of the cost of raising, it is not to be understood as applying in other cases, but still it is an approximation to what others may effect. The estimate will vary most in the product per acre, which in seasons not decidedly unfavorable may run all the way with good farmers from sixty up to three hundred bushels per acre. In extreme cases, we have exceeded the highest named amount; while last year, so generally a failure, the crop fell below the lowest.

ESTIMATE FOR ONE ACRE.

Plowing twice	$5.00
Harrowing and furrowing	2.00
Planting, two men two days	5.00
Three or four dressings with smoothing harrow	1.00
Three dressings with cultivator	2.00
One day in all with Paris green	1.50
Digging and drawing in	7.00
Interest on land	7.00
Total	$30.50

An average estimate of 120 bushels per acre would give the entire cost at about 25 cents per bushel, including the use of the land.

We are aware that other estimates will vary greatly from this both above and below it, but we think this a fair average for many good farming districts of this State. No other annual crop, however, varies so much as the potato, and doubtless estimates will run all the way from twelve or fifteen cents per bushel to fifty or even seventy-five. A great deal depends on the variety planted, and this selection must vary with the locality. The Peerless, for example, has proved not only productive, but the best in quality for the table of all the many sorts we have tried on a strong, rather clayey soil, while in other places it is perfectly worthless. Among other profitable and productive sorts, we may mention Early Vermont, Late Rose, and a new variety raised by George W. Campbell, which he names Ohio Beauty, and which somewhat resembles Brownell's Beauty. It would be profitable for farmers who cultivate many potatoes, to try all the leading sorts to a limited extent on their own grounds, and to adopt those which succeed best and prove most profitable; and if they can procure a change of seed from a distance, where the soil varies, especially if generally better for potato culture, they would be likely to be more than repaid for this trouble.—*Country Gentleman.*

A SUGGESTION FOR WINTER STRAWBERRIES.

AN English journal states that "about ten thousand strawberry plants are annually forced in pots in the gardens of Sandringham (the Prince of Wales' palace). The usual course with all the earlier batches is to start them in pots plunged in warm leaves; they are then placed on shelves anywhere and everywhere that room can be found for them and gathered in quantity from the middle of February till they come in out of doors." Commenting on this item, Thomas Meehan, of the *Press*, remarks that the popular view to the contrary notwithstanding, such luxuries are less costly than they seem, and that royalty ought not be permitted to monopolize them. As a matter of course, to have strawberries very much in advance of their season it would be necessary to grow them a few months in pots, and take care of them much as is described in the extract quoted, but many persons might have them at a little later date without this trouble, by simply covering the ground in which they grow with a few hot bed sash. It is remarkable, Mr. Meehan thinks, that country gardeners do not make more use of glass frames for getting things earlier than they do. Glass is cheap and the sash frames are not very costly. One can glaze for himself, and any farmer can make frames good enough for the purpose. They come into use in so many ways that every farm garden ought to have a few of these sashes on hand. For strawberries all that is necessary is to have a bed growing on some nice warm spot of ground, and then set one of the frames over it. It takes very little heat to bring forth strawberry blossoms, and the glass covering protects them from frost and cold at night. A frame five feet wide and twenty feet long, fixed in this way, would give many quarts of strawberries for several weeks before the regular crops come in the open ground.—*N. Y. Tribune.*

Many years ago we were presented with a large plant growing in a pot, full of strawberries, the largest ripe, at Christmas, besides a good mess of luscious strawberries for our Christmas dessert. They were grown by Mr. George Miller of Millersville, Anne Arundel Co. He took up some 50 vines in October, and put them, some in pots and others in the earth of an old spent hot bed, and put on the glass. Seeing that they soon blossomed, he packed manure around the sides of the frame so as to increase the heat, and they went on to bear and perfect their fruit as if it were June. Who should not every one who has hot bed sashes, have strawberries in winter?—*The Maryland Farmer.*

TO DESTROY CHICKEN LICE.

AN exchange gives the following recipe for getting rid of these pests:

Last summer our hen house was so infested with this vermin that the setting hens died on their nests. One afternoon I noticed the martins carrying to their box—which was on a pole above the henery—some green leaves. Watching them I found they were getting the leaves of the male persimmon. I gathered some of the leaves, threw them into the nests on the hen-house floor, and in less than one hour the house was free from the vermin. To boil the leaves and sprinkle with the decoction will be as effective.—*Southern Cultivator.*

WE are informed, says a contemporary, that the Belgian Government, after trying for some time fifty kilometers, or thirty-two miles, of Hilf's wrought iron permanent way, have been so much satisfied with the results, that they have just ordered another thirty-two miles of it. In Germany, the adoption of this system is making rapid strides, nearly 1,000 miles of it being either in use or in course of construction. One of the large English railway companies has ordered a trial mile.

SCIENTIFIC AMERICAN CHESS RECORD.

[All contributions intended for this department, may be addressed to Samuel Loyd, Elizabeth, N. J.]

PROBLEM No. 42. By L. W. MUDGE.

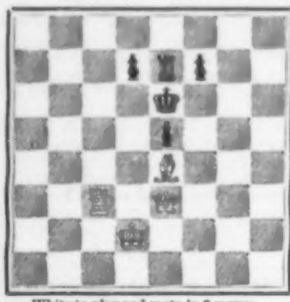
Brownson's Tourney.

Black.

White.

White to play and mate in four moves.

REV. L. W. MUDGE, PRINCETON, N. J.



White to play and mate in 3 moves. By L. W. MUDGE.

JUSTICE to the skill and good taste of Mr. Mudge induces us to say that our selection of his problems are far below his average standard of excellence, and are given as showing in which tournaments he has been a successful prize bearer. No. 42 received the prize in Brownson's Tourney of '72 for the position having the most variations, in a competition of one hundred problems. No. 43 was one of the set that received the first prize in the recent Hartford *Globe* Tourney, and will be found to be a very puzzling little position.

The initial letter received the second prize in the Centennial Letter Tourney, and is one of the neatest problems of this description that has ever come under our notice. Mr. Mudge has shown a peculiar talent for oddities of this kind; some of his fantasies entered in the Centennial contest are remarkably clever.

Besides being recognized as a prolific and careful composer, he is well known as a critic on problematical questions, and is a most successful analyst, having carried off the honors in quite a number of solving contests, against a field of experts. He is a brilliant player who should belong to the foremost ranks, but aside from playing a few games by correspondence, his chess hours are devoted to the strategetical branch of the art, for the advancement of which he is a most enthusiastic worker and liberal patron.

It is worthy of note that many of our most distinguished players, problemists and chess authors have belonged to the clerical profession.

JUDD VS. ALBERONI.

THIS interesting match was played in January, 1876, between Monsieur Alberoni, a distinguished visitor from the French capital, who has been visiting the States and taken part in many chess contests throughout the country, and the St. Louis champion, Max Judd. The conditions of the match were according to the rules of Staunton's Praxis. The time limited to fifteen moves an hour, the winner of the first six games, exclusive of draws, to be declared the victor. The result was, Judd won six, lost two, drew four. We herewith present the concluding game of the match.

ALBERONI. WHITE.	JUDD. BLACK.
1. P to Q B 4	1. P to K B 4
2. P to K 3	2. Kt to K B 3
3. Kt to Q B 3	3. P to K 3
4. P to Q 4	4. P to Q Kt 3
5. P to K B 3	5. B to Q Kt 2
6. B to Q 3	6. P to K Kt 3
7. P to K 4	7. P x P
8. P x P	8. Kt to Q B 3
9. Kt to K B 3	9. P to Q 3
10. B to Kt 5	10. B to K 2
11. P to Q 5	11. P x P
12. B P x P	12. Kt to K 4
13. Kt x Kt	13. P x Kt
14. B x Kt	14. B x B
15. B to Kt 5 ch	15. K to B 2
16. Q to K 2	16. Q to Q 3
17. Castles Q R	17. P to Q R 3
18. B to R 4	18. K to Kt 2
19. P to K R 4	19. K R to K B sq
20. P to K Kt 4	20. P to Q Kt 4
21. B to B 2	21. P to Q Kt 5
22. Kt to R 4	22. B to K 2
23. K to Kt sq	23. P to Q R 4
24. P to Kt 5	24. R to B 5
25. B to Q 3	25. Q R to K B sq
26. Q to Q B 2	26. R to K B 7
27. Q to B 4	27. R to Q R sq
28. B to B sq	28. B to R 3
29. Q to B sq	29. R to Kt 3
30. Q to K 3	30. R to K B 5
31. R to Kt 3	31. Q R to K B sq
32. Q R to Q B sq	32. R to B sq
33. Q R to K B sq	33. R x R
34. B x R	34. B to Q 2
35. P to Kt 3	35. B x Kt
36. P x B	36. Q to B 4
37. Q x Q	37. R x Q
38. K to B 2	38. R to B 7 ch
39. K to Kt 3	39. B to Q 5
40. R to R 6	40. R to Q Kt 7 ch
41. K to B 4	41. P to Q R 7 ch.
42. K to Q 3	42. R x R P
43. B to B 4	43. R to R 6 ch
44. K to Q 2	44. B to K 6 ch
45. K to K 2	45. B to B 5
46. B to Kt 3	46. R to K 6 ch
47. K to B 2	47. R x P
48. R to Q sq	48. R to Q 5
49. R x R	49. P x R
50. K to B 3	50. B to Q 3
51. K to K 4	51. B to Kt 6
52. K x P	52. B x P
53. K to B 5	53. B x P
54. B to B 4	54. B to K 6 ch
55. K to B 6	55. P to R 4
56. K x P	56. P to R 5
57. P to Q 6	57. P to R 6
58. P to Q 7	58. B to Kt 4
59. P queens	59. B x Q
60. K x B	60. P to R 7
61. B to K 4	61. P to Kt 6
62. K to B 2	62. P to Kt 7, winning the game and the match.

Lewis W. Mudge

PROBLEM TOURNAMENTS FOR '78.

THE *Danbury News man* is out again with a second problem tournament before his first is fairly closed. He terms it:

ANOTHER SHORT PROBLEM TOURNEY.

Problems may now be entered for our new tourney.

The conditions will be as usual as regards mottoes, sealed envelopes, etc.

The prizes will be as follows:

For the best three-move problem	$10 00
For the second best three-move problem	6 00
For the third best three-move problem	4 00
For the best two-move problem, *The Danbury News* for one year.	

There will be no entrance fee charged. Each composer may enter as many compositions as he pleases.

No composer will be awarded more than one prize for three-move productions.

Problems may be entered up to March 1st.

Foreign composers will be allowed until March 14th.

The award will be made as soon as possible after the completion of the publication of the problems communicated.

Mrs. Ella Spencer, the well known lady chess player, offers five dollars in gold through Dexter Smith's *Musical Review*, for the best problem in two moves.

The entire editorial fraternity are becoming interested in the Association Problem Tourney, and are adding new prizes to the already liberal programme. Mr. W. A. Ballantine, of this city, who won the recent amateur prize, authorizes us to offer a pretty set of chess men of the value of ten dollars for the most beautiful problem of the tournament. It will be awarded upon the basis that problematical beauty may be defined as *difficulty of solution, effected by a limited number of pieces.* To decide the question of superiority the problems will be graded according to actual difficulty from one to fifty points, from which there will be a reduction of one point for each piece employed in the construction of the position. Of course, it is understood that "British born subjects" are cordially invited to compete for all of these prizes.

CAPT. KENNEDY says: It is a common complaint with chess players, when pitted against an opponent stronger than themselves, that they "appear to have no pieces on the board." A worthy friend of mine, with whom I am accustomed to play a good deal, when his game chances to be bad, and his pieces are in a dead fix, is in the habit of abusing them fiercely, as if they possessed an independent volition, and had brought him into trouble of their own accord. "Look at that lumbering old thief of a castle," he will perhaps say to a looker-on, "of what use is he to me? Never moved once—he might as well be off the board."

PROBLEM No. 43. By L. W. MUDGE, First Prize.

Hartford *Globe* Tourney.

Black.

White.

White to play and mate in two moves.

SOLUTIONS TO PROBLEMS.

No. 35.—BY T. M. BROWN.

WHITE.	BLACK.
1. K to Q 6	1. B x P dis ch (best)
2. Kt to Q 5	2. R to Q 2 ch (best)
3. B x R dis ch	3. R x R
4. B to B 5 ch	4. K x R
5. Kt x Q mate.	

No. 36.—BY J. PATTERSON.

WHITE.	BLACK.
1. Q to R sq	1. B x Q
2. Kt to K R 5	2. K x R
3. Kt to B 4 mate.	
	1. B to B 6
2. Kt to Kt 4 ch	2. K x P
3. Q to K Kt sq mate.	
	1. B to B 8
2. Kt to Kt 4 ch	2. K x P
3. Q x P mate.	

Letter "U."—BY DR. C. C. MOORE.

WHITE.	BLACK.
1. R x P ch	1. K x B
2. P Kts	2. K x P
3. R to Q 4 mate.	
	1. K to B 6
2. B to R 2	2. K to B 7
3. R to B 4 mate.	

A BLACK bishop should be placed on king's bishop's square, on the spectrum problem of last issue.

THE HARTFORD GLOBE PROBLEM TOURNAMENT.

IN our issue of October 13 we gave two of the winning problems of this interesting little contest. We present one of Mr. Mudge's problems as No. 43, which, with the following, received the first prize.

ENIGMA No. 6.—BY L. W. MUDGE.

White.—K on Q Kt 5, Q K B 7, Rs K R 3 and Q B sq, Bs K 7 and Q B 8, Kts K 6 and Q Kt sq, Ps K B 5 and Q B 3.

Black.—K on K 6, B K B 6, Ps K B 5, Q B 4 and 5, and Q Kt 3.

White mates in three moves.

ENIGMA No. 7.—BY F. W. MARTINDALE.—THIRD PRIZE.

White.—K on K R 4, Q Q B 5, Rs Q R 6 and Q 2, B Q B 6, Kt K Kt 5, Ps K 3, K B 6 and K R 6.

Black.—K on K B 4, R K B 2, Kts Q 8, Q Kt 6, P Q B 2, K 4 and 5, K Kt 2 and K R 2.

White to play and mate in two moves.

ENIGMA No. 8.—BY F. W. MARTINDALE.—THIRD PRIZE.

White.—K on K Kt 7, Rs K B 3 and Q 4, B Q sq and Q 6, Kt Q Kt 7, P Q B 7.

Black.—K on K 3, R Q B sq, B Q 2, Kt K B sq and K Kt 7, Ps K B 4, Q 4, Q B 3 and 5 and Q B 6.

White mates in three moves.

ENIGMA No. 9.—BY R. H. SEYMOUR.—FOURTH PRIZE.

White.—K on K B 3, Q on Q B 8, R Q Kt 3, B Q R 7, Kts Q R 3 and Q B 2, Ps Q 6, K B 6 and K Kt 3.

Black.—K on Q 4, B K Kt sq, P Q R 3 and 4, Q Kt 3 and Q 5.

White to play and mate in three moves.

ENIGMA No. 10.—BY X. HAWKINS.—FIFTH PRIZE.

White.—K on K R 3, Q K 2, R K Kt 5, B Q Kt 4, P K B 3 and 4, and Q Kt 5.

Black.—K on Q 5, Kt K B 8, P Q Kt 3, Q B 5, K B 3 and 4, and K Kt 3.

White to play and mate in two moves.

ENIGMA No. 11.—BY X. HAWKINS.—FIFTH PRIZE.

White.—K on Q 2, Q K Kt 6, R Q B 3, Bs Q 8 and K R sq, Kt Q R 5, and K sq, Ps Q 3 and 5, K 2, K R 2 and 4.

Black.—K on Q 5, Bs K 4 and K Kt 5, Kt Q B 4, Ps K R 6, K B 4 and 5, Q 3, Q Kt 2, 4 and 6.

White to play and mate in two moves.

The remaining prize-bearing problem, by Mr. Wash, we reserve to accompany his portrait.